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The serious loss in the recent Delavan House fire at Albany, N. Y., is said to have been largely due to a lack of water. The present pumping works are said to be deficient in capacity, so that the supply is shut down or checked during the night. It is alleged that there was a long delay in raising the pressure after the fire alarm was sent in, so that it was some time before the water could be thrown by steamers above the second story. For a number of years a new water supply for Albany has been under discussion, and meanwhile there has been a disinclination to add to the present river pumping plant. At both Albany and Troy schemes for new gravity supplies have recently been worked out in detail, only to be defeated in the City Council, it is currently said, through the influence of political bosses who feared there was "nothing in it" for them. Albany is not only short of water, but is drinking the Hudson River water, which is believed to be dangerously polluted with the sewage of the up-river towns.

Kentucky "rock asphalt" is to be tried for paving a street in Buffalo, N. Y., after some considerable debate as to its merits compared with Trinidad asphalt. The contract for paving with this material was finally awarded to J. E. Vorhees & Son at $1.65 per sq. yd., with $2 for cuts and openings, 60 cts. per ft. for limestone curbing and 30 cts. per ft. for redressing and setting curbstones.

The advantages of conducting public works on a business instead of a political basis are shown by the report of Mr. Alfred T. White, Commissioner of City Works, Brooklyn, for the eleven months ending Nov. 30, 1894. The full report has not yet been made public, but from the extracts which have appeared in the daily papers, it is evident that in some departments much more work has been accomplished than in former years, and at a greatly reduced cost, even after taking into account the cheaper prices for labor and material which prevailed in 1894. One of the greatest difficulties encountered in connection with keeping the streets clean and in good repair is the constant tearing up of the streets by private corporations. During the year 112 miles of streets were torn up in this way, or nearly one-third of the total mileage of paved streets.

The Rapid Transit Commissioners of New York have decided to give two public hearings on the best method of constructing the proposed lines, and the meeting will be at 2 p. m. on Jan. 13 and 18.

Arrangements have been completed for the national convention of manufacturers to be held in Cincinnati, Jan. 22, as announced in our issue of Nov. 29. A National Association is to be organized at this meeting, the objects of which will be the consideration of national questions and legislation affecting manufacturing interests, especially the promotion of the export trade, the extension of the commercial marine and government aid to the Nicaragua canal. The committee of invitation includes Robert Laidlaw, of the Laidlaw-Dunn-Gordon Co.; W. A. Proctor, of the Proctor & Gamble Co., and Charles Davis, of the Lodge & Davis Machine Tool Co. The secretary is E. P. Wilson, Chamber of Commerce, Cincinnati, O.

A railway bridge across the Detroit River, near Detroit, is proposed by the Canadian & Michigan Tunnel Co. The Ottawa item referring to the application to the Canadian Parliament for power to build says it is to be a drawbridge, with spans of "not less than 1,000 ft."

The Chicago Drainage Commission, through its Committee on Finance and Engineering and the Chief Engineer, has reorganized the engineering department. The power of the department will be centered in the Chief Engineer, and the affairs of the department will be conducted with a maximum of 100 men. In this rearrangement of the force 37 men will be discharged, and a saving effected of $45,000 per annum.

The most serious railway accident of the week was a head collision of freight trains Jan. 1 at Yorktown, Ind., on the Cleveland, Cincinnati, Chicago & St. Louis Ry. One man was killed and three were injured, one fatally. A misunderstanding of train orders caused the accident.

A collision of electric cars occurred in Brooklyn, N. Y., Jan. 1, at the intersection of the Brooklyn City Ry. line on Fulton St. and the Brooklyn & Newtown Ry. on Franklin Ave. A motor car, running at high speed on the former line, struck the rear and front platforms of a motor car and trail car on the latter line, smashing the platforms and derailing the trail car. Seven persons were injured. The officers of the road attributed the accident to carelessness on the part of the motorman of the Brooklyn City Ry. car, in not observing a rule to slow down for the crossing, but the man claimed that the tracks were slippery and that the brakes would not hold the car on the grade.

Runaways of electric cars were caused at Rondout, N. Y., and Manayunk, Pa., on Jan. 6, by the coating of ice on the rails. A car from Kingston to Rondout ran away when descending the steep Broadway hill, jumped the track and ran into a brick building. The motorman was fatally injured and two or three passengers were slightly injured. The Manayunk car was descending the Leverington Ave. hill when it got beyond control, was derailed at a curve and ran into a gas-lamp and trolley wire pole. The motorman had his leg broken.

Mayor Wanser, of Jersey City, has recommended that the Board of Street and Water Commissioners prepare specifications and secure bids for a new water supply under four different plans, as follows: (1) For a gravity supply for all parts of the city; (2) For a gravity supply to Belleville, the high-service pumping plant to be continued; (3) For a pumping supply delivered into the Belleville reservoir; (4) For a supply of filtered water. The mayor advises that bids be received no earlier than March 1.

The securing of land for the new 1,500,000,000-gallon Jerome Park reservoir for New York city is nearly completed and it is reported that bids for its construction will soon be requested.

Chicago may now add to its many claims for bigness that it uses and wastes more water than any other city in the world. Its water consumption, in 1894, as indicated by the pumpage at the eight city pumping stations, averaged 238,372,300 gallons a day, making a total for the year of slightly over 87,000,000,000 gallons. This is probably the largest amount of water used by any city in the world, London being the closest rival, its consumption in 1892 having been 216,000,000 U. S. gallons per day. As this was an increase of about 14,000,000 gallons over the consumption in 1890, it may be assumed that the London daily consumption in 1894 was between 230,000,000 and 235,000,000 gallons. Next comes Philadelphia, with a daily consumption of 197,344,806 gallons in 1894, which, like the supply of Chicago and London, is all pumped. Fourth in the list is New York, with a gravity supply of 183,000,000 gallons in 1894, some of which, however, had to be pumped for the high service. The daily per capita consumption in these four cities ranges from about 40 U. S. gallons for London, to somewhere in the vicinity of 160 gallons for Philadelphia. The exact figures for the American cities cannot be given, owing to uncertainties as to their exact population, but, allowing 1,925,000 inhabitants as an average for New York in 1894, it used about 95 gallons daily for each individual. If the population of Philadelphia be taken at 1,225,000, its consumption was about 160 gallons, while crediting Chicago with 1,600,000 people, gives it an allowance of about 150 gallons for every man, woman and child within its wide borders. Only a part of London has a constant supply, or, in other words, can draw water from its pumping fixtures at all hours of the day or night. In this country the supply is not only constant, but the waste, also, is too often constant, which partially accounts for the high per capita figures for Chicago and Philadelphia, which are surpassed, however, by many scores in some other American cities. We are indebted to Mr. Geo. W. Birdsall, Chief Engineer of the Croton Aqueduct, of New York, and to Mr. John L. Ogden, Chief of the Philadelphia Bureau of Water, for the figures of consumption for the two cities named. The figures for Chicago are from the recently submitted reports of its Department of Public Works, and the London figures are from the Report of the Local Government Board for 1892-3.

A canal improvement bill has been prepared for presentation to the New York State legislature, making provision for the issue of bonds to an amount not to exceed $9,000,000 for the improvement of the Erie, Champlain and Oswego canals, and providing for a submission of the same to the people, to be voted upon at the next general election. The bill provides that the legislature shall annually impose a tax on real and personal property in the state, the proceeds of which, after paying the interest due on the bonds, to be invested by the Controller under the direction of the Commissioner of the Canal Fund in a sinking fund created for this purpose, payment from which shall be used in buying the bonds when due. Within three months after the issuance of the bonds the Superintendent of Public Works is to proceed to enlarge the canals mentioned. The improvements to the Erie and Oswego canals are to consist in deepening them to 9 ft., except at aqueducts, culverts, etc., where the water will be 8 ft. deep, and the lengthening and improvment of the locks. The Champlain Canal is to be deepened to 7 ft.

A paving exhibition is to be held at St. Paul, Minn., in April, under the management of the St. Paul Commercial Club, and extensive exhibits are anticipated.

Steel beams as frames for lining mining shafts are being tried by the H. C. Frick Coke Co., of Connellsville, Pa., as a substitute for timbering.

Cracks have developed in one of the new reservoirs, known as No. 3, at Portland, Ore., described briefly in our issue of Nov. 15, 1894. This reservoir is located in City Park, on the west side, and is lined with 5 to 6 ins. of concrete, with ⅝-in. square twisted rods bedded in the concrete every 2 ft. in each direction and anchored to iron posts. The concrete was finally covered with California asphalt. The banks were full of springs, and to remove the water from them, a system of drains was laid below the lining, all as described in the issue named above. The Committee of One Hundred has received a report from Mr. J. N. Teal, of a sub-committee on the water-works, to the effect that cracks developed in the lining last September, "presumably due to the earth becoming saturated, without the water being able to escape." A buttress was afterwards built against one of the banks to avert any danger to the structure. On Dec. 13 orders were given to admit water to the reservoir and on carrying out these orders further cracks appeared in the bottom lining. The cracks appear to be caused by a buckling of the lining. Mr. Teal reports that the cracks must be due to either an upward pressure of water beneath the lining or to a slow sliding of the reservoir bank. Mr. Jas. D. Schuyler, M. Am. Soc. C. E., San Diego, Cal., was in charge of this work as consulting engineer, and Mr. Isaac Smith is engineer to the water committee of Portland.

The complaints against the speed at which electric cars are run in Brooklyn, N. Y., have led to an inquiry on the part of the Railroad Commissioners of the state. One speaker stated that he had frequently timed cars at 18 miles an hour, and an average of 57 cars timed showed a speed of 13½ miles per hour, the legal limit being 10 miles. In regard to the crossings of street-car lines, the president of one road said that the men were only required to slow down, and that the recent collision at Fulton St. and Franklin Ave. was due to one of the motormen not obeying this rule. As to the fenders, another president said that 50 or 60 had been tried, none of which were entirely effective. The presidents of four roads declared that their schedules do not call for speeds in excess of the legal rate, but the employees are understood to claim that the schedules are cut so close that any detentions by frequent stops, etc., render it necessary to use high speed in order to keep on time.

PORTLAND CEMENT WORKS OF THE WHITAKER CEMENT CO.

While Portland cement is quite extensively manufactured in this country, the greater proportion has a certain amount of limestone added before burning, owing to the deficiency of lime in the natural rock. In some cases, however, as at Whitaker, N. J., and formerly at some of the cement rock quarries at Coplay, Pa., the character of the rock is such that the cement can be made directly from it, without the addition of limestone or other ingredients. The Coplay rock, however, does not contain a sufficient proportion of lime to make Portland cement which will meet present requirements, and it is now always used with an addition of limestone. In the present article we describe the cement manufacturing plant at Whitaker, N. J., the special features of which are that the cement is made directly from the quarried rock, and that the rotary kiln system of burning is employed, which system is used by only three or four works in this country. The quarries and works are owned by the Whitaker Cement Co., of Easton, Pa., of which Mr. Thomas D. Whitaker is President, and Mr. Paul S. King, M. Am. Soc. C. E., is General Manager.

The surrounding country abounds in dolomite limestone, high in magnesia, but the cement rock is an outcropping vein of argillaceous limestone, practically free from magnesia and containing the right proportion of lime for a triple-silicate Portland cement. The vein extends over about 55 acres of the company's land and is about 400 ft. thick. The surface rock is somewhat disintegrated, and though of good quality is not used. The rock is blasted by dynamite, and the quarry is now down about 50 ft., so that an inclined plane and winding engine are being installed to replace the wagons now used in hauling the rock out of the quarry to the works, which are close at hand. The material from different parts of the quarry shows a very uniform analysis, averaging about as follows:

	Per cent.
Silica	14.44
Alumina and sesquioxide of iron	5.91
Carbonate of lime	75.17
Carbonate of magnesia	.77

The course of the material and the series of varied operations through which it passes on its way from the quarry to the storage bin are described below, and may be followed by reference to the plan Fig. 1. From the quarry the cars are hauled to the second floor of the mill on the track, A, and the stone dumped to the floor below at B. The stone then goes through the Blake crusher, C, and cracker, D, the crushed material then being raised by the chain bucket elevator, E, to the belt conveyor, F, on the second floor, by which it is conveyed to the store bins, H. At G, on the second floor, is a dryer used for wet stone. From the bin H the crushed rock is fed to five Griffin grinding mills, J, by which it is ground to an impalpable powder. The ground raw material is then conveyed by the spiral conveyor, K, to the elevator, L, which raises it to the second floor, discharging it into another conveyor, M, leading to the raw material bins, N. From the bottom of each of these bins a spiral conveyor feeds the powdered rock into a chute which discharges into the bottom of the higher end of an inclined rotating cylinder, O. There are four of these cylinders, as shown, but the one on the first floor is to be removed to the second floor, for greater convenience in the discharge of the clinker. These cylinders, shown in Fig. 2, are the kilns in

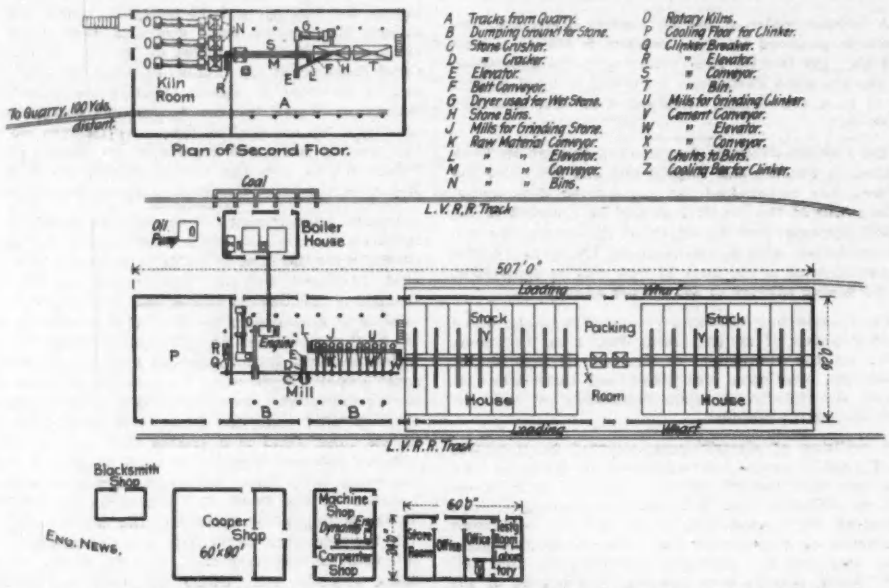

FIG. 1. PLAN OF WORKS OF THE WHITAKER CEMENT CO., WHITAKER, N. J.

which the powdered rock is burnt at a high temperature by oil fuel sprayed in by compressed air, the moisture and carbonic acid being driven off and passing out of the stacks. From the lower end of the cylinder the burnt material, or "clinker," drops into a cooling chamber, Z, whence it falls to the cooling floor, P, below. From the pile on this lower floor the clinker is wheeled to a breaker, Q, below the floor level, where any large pieces are broken up, the granular product (resembling small dark gravel) being then carried by a chain bucket elevator, R, and traveling rubber belt, S, to the stock box, T, above the grinding mills, U, which are also of the Griffin make, and from these the finished product is carried by the spiral conveyor, V, and chain bucket elevator, W, to a conveyor running in a trunk along the stock house, from which chutes, Y, lead to the 32 storage bins. For packing, the cement is shoveled from the bins to a spiral conveyor in a trough along the floor, and raised by an elevator to a mixing box in the packing room, from the hopper of which it falls into the barrel, sack, or paper bag, ready for shipment on the railway cars standing on spur tracks from the Lehigh Valley R. R.

The rotary-cylinder process of burning has been tried in Europe, but while it has made excellent cement, it has been too expensive, owing to the higher cost of oil fuel, while the material from which cement is made in Europe is said to be generally too bulky and also too refractory for the most satisfactory results with this process. The Whitaker Cement Co., however, finds the process the least expensive and the most satisfactory. It says that the finely-powdered rock is more thoroughly burned as it passes slowly in a finely-divided state from one end of the cylinder to the other (dropping from the sides and top through the intensely hot flame at the cylinder revolves), than cement made up in bricks and burnt in a stationary kiln, according to the common process. Natural draft is employed. The cylinders are 30 to 40 ft. long, about 5 ft. outside diameter, built of boiler plate and well lined with 6 ins. of soft firebrick, and revolved by means of gearing driving a cylinder rack on the middle of the barrel, each kiln being driven separately by a 5-HP. Westinghouse engine, so that the speed of output and consequent extent of burning of the material of each kiln can be regulated by the men in charge. The ordinary speed is about ⅝ of a revolution per minute, and the cement is in the cylinder for about two hours. The ends of the cylinder are supported by live rollers and circular bearings, and the upper end revolves in a water-jacketed chamber through which the cement chute enters. The lower end of the cylinder enters a water-jacket chamber carrying the two nozzles or burners through which the air and oil are forced at a pressure of 15 lbs. per sq. in at the burner. The heat is from 3,000 to 3,500° F. Peep-holes are provided, so that the men can watch the process, black glasses being used to protect the eyes. Lima oil is used for fuel, the oil being delivered from tank cars into a storage tank of 36,000 gallons capacity, and thence to a smaller supply tank, from which it flows by gravity to the oil pump, which is placed by itself in a small isolated brick building, to ensure safety from fire. The consumption is about 4,500 gallons per day. The oil fuel system is that of the Aerated Fuel Co., and some experiments have been made with a fuel gas system.

Various types of grinding machines have been tried, and the Griffin mill, made by the Bradley Pulverizer Co., of Boston, Mass., was finally adopted, on account of the fineness of the product, for, as is well known, the quality of the cement increases with the degree of fineness. The company guarantees that 70% of the finished product will pass through a No. 200 sieve (40,000 holes per sq. in.). The cement is usually in the storage bins for three to six weeks before being packed for shipment.

Samples are taken and tests made of the contents of each bin, and the results of the test carefully recorded, so that if any particular quality of cement is required for special purposes, as, for instance, a quick-setting cement for bridge masonry, it can be furnished exactly to the specifications by mixing the contents of certain bins in the mixing box above referred to. The average quality of the product is so uniform, however, that it is only in special cases that such treatment is required. Samples of the cement and powdered rock are taken daily. Briquettes of neat cement show an average tensile strength of 625 lbs. per sq. in. in 7 days, 875 lbs. in 28 days and 913 lbs. in 6 months. Briquettes of 1 cement and 3 sand show an average of 191 lbs. in 7 days, 295 lbs. in 28 days and 343 lbs. in 6 months. The cement is guaranteed to show in 7 days (1 in air and 6 in water) a minimum tensile strain of 400 lbs. per sq. in. for neat briquettes and 125 lbs. for briquettes of 1 cement to 3 sand, standard crushed quartz being used. Boiling tests are also made, as

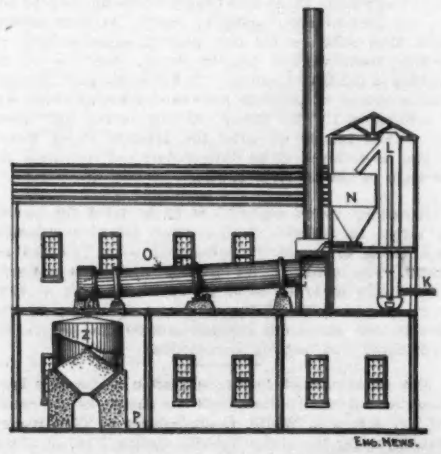

Fig. 2. Rotary Kiln for Burning Portland Cement; Whitaker Cement Works.

a matter of safety, to see if there is any excess of free lime. The analyses of the finished product average as follows:

	Per cent.
Silica	21.70
Alumina and sesquioxide of iron	8.88
Lime	63.27
Magnesia	.55

The works have a capacity of 400 barrels per day, or an average of 100 barrels from each of the four kilns. They have been in operation for about 2½ years, but the buildings were burned in January last, and have been replaced by iron buildings, with brick and corrugated iron walls, and corrugated iron roofs. The floors are of concrete, and concrete (made from the refuse cement) is largely used for foundations, floors, the piers of the coal

TABLE I.—CONSECUTIVE RECORD OF SEWER JOINT EXPERIMENTS.

No.	Form of socket.	Form of joint.	Kind of cement.	Mixture of cement.	Time setting.	Duration of test.	Leakage, gals. per mile per 24 hrs.	Remarks.
1	Standard.	Flush.	Rosendale.	1 to 1	12 hrs.	3 hrs.	404	
2	"	"	"	Neat.	12 "	3 min.	127,800	Very minute cracks.
3	"	"	"	"	12 "	15 "	285,000	
4	"	Overfilled.	"	"	12 "	3 hrs.	507	
5	"	"	"	"	12 "	20 min.	324,000	Minute cracks.
6	"	"	"	1 to 1	12 "	11 hrs.	157	
7	"	"	"	"	12 "	8.5"	102	Mortar very dry.
7A	"	"	"	"	12 days.	12 "	78	No. 7 repeated.
8	Deep.	Flush.	"	"	12 hrs.	9.5"	538	
9	"	"	"	"	12 "	7 "	950	
10	"	"	"	Neat.	12 "	15 min.	285,000	Minute cracks.
10A	"	"	"	"	36 "	23 "	191,000	In water 24 hrs., no press.
11	"	Flush.	"	1 to 1	6 "	20 "	216,000	
11A	"	"	"	"	16 "	40 "	160,300	No. 11 repeated.
12	"	"	"	Neat.	12 "	17 "	251,500	
12A	"	"	"	"	18 "	7 "	272,000	No. 12 repeated.
13	"	"	"	1 to 1	6 "	5 hrs.	351	
14	"	"	"	"	12 "	7 "	1,056	*Sat. with neat Ros'ndale
14A	"	"	"	"	43 "	11.5"	823	
15	....	....	....	....	....	....	....	Made poor c'm't, not tested
16	Deep.	Overfilled.	Rosendale.	1 to 1	12 hrs.	7.66 hrs.	263	
17	"	"	"	"	12 "	11.25 "	591	
18	"	"	"	Neat.	12 "	6 "	285	
19	"	"	"	"	12 "	2.83 "	4,280	
19A	"	"	"	"	24 "	.5 "	4,330	
20	"	Flush.	"	1 to 1	12 "	1.5 "	486	Grooved socket.
21	"	"	"	"	3 "	1.33 "	859	
22	"	"	"	"	1½"	.83 "	925	Mortar very dry
23	"	"	"	"	6 "	.58 "	2,374	Mortar rather wet.
24	"	"	"	"	36 "	10 "	436	Grooved socket.
25	Standard.	"	"	"	12 "	5 "	3,605	
26	Deep.	"	"	"	12 "	.5 "	7,240	Grooved socket.
27	"	"	"	"	1½"	8.25 "	437	
28	"	"	"	1 to 2	12 "	11.5 "	1,648	
29	"	....	....	....	....	....	....	Moved in joint; not tested.
30	"	Overfilled.	Rosendale.	1 to 1	10 days.	2 hrs.	2,370	From poor lot of cement.
31	"	Flush.	"	1 to 2	12 hrs.	2.16 "	766	
32	"	"	"	Neat.	3 "	1 "	6,290	
33	"	"	"	"	3 "	.42 "	15,080	Grooved socket.
34	"	"	"	1 to 1	3 "	1 "	3,840	Suspect this moved.
35	"	"	"	"	3 "	5 "	616	
36	"	"	"	"	16 days.	19 min.	100,000	No. 11 and 11A repeated.
37	"	"	"	"	24 hrs.	11 hrs.	348	
38	"	"	"	"	....	8.5 "	82	No. 27 painted asphalt.
39	"	"	"	"	24 hrs.	3 "	1,538	Grooved socket.
40	"	"	"	"	....	2 "	713	No. 26 repeated, asphalt.
41	"	"	Portland.	"	12 hrs.	2 "	304	
42	"	"	"	"	1½"	1.58 "	765	
43	"	"	"	Neat.	1½"	1 "	59	
44	"	"	"	"	1½"	1.75 "	337	
45	"	"	"	1 to 1	12 "	8 "	368	
46	"	"	Rosendale.	1 to 2	....	4.75 "	1,060	No. 28 painted asphalt.
47	"	Overfilled.	"**	1 to 1	....	8 "	740	No. 30 " "
48	Standard.	"	"	"	....	12 "	..	No. 7 " "
49	"	Flush.	"	"	....	9 "	105	No. 25 " "
50	Deep.	"	Portland.	"	1½"	2 "	945	
51	"	"	Rosendale.	"	..	9 "	..	No. 30 painted asphalt.
52	"	"	"	"	12 "	2.5 "	236	½-neat, Portland on top.
53	"	"	Portland.	Neat.	12 "	7.5 "	39	
54	"	Overfilled.	Rosendale.	"	....	12 "	..	No. 18 painted asphalt.
55	"	Flush.	"	1 to 1	....	1.33 "	8,350	No. 11 painted asphalt.
56	"	"	Portland.	Neat.	12 hrs.	12 "	98	Mixed wet.
57	"	"	"	1 to 1	....	5.75 "	41	No. 45 painted asphalt.
58	"	"	Rosendale.	"	12 hrs.	12 "	238	½-neat, Portland on top.
59	"	"	Portland.	Neat.	1½"	6 "	118	Made lying on its side.
60	"	"	"	"	12 "	7½ "	323	Gasket sat. with cement.
61	Standard.	Overfilled.	"	"	12 "	12 "	67	Made very wet.
62	Deep.	Flush.	Rosendale.	1 to 1	12 "	.25 "	10,410	Made very dry.
63	"	"	"	"	12 "	10½ "	776	Made very wet.

* Jute gasket saturated. ** Poor.

TABLE II.—Quantity and Cost of Cement in Deep Sockets, with Flush Joints (Fig. 4).

Diam. pipe, ins.	Contents, cu. ft.	Cost in cents. Portland cement. Neat.	Portland cement. 1 to 1.	Rosendale cement. Neat.	Rosendale cement. 1 to 1.
4	.0191	10.7	6.0	6.0	3.50
5	.0234	1.4	0.8	0.8	0.46
6	.0267	1.7	1.0	1.0	0.58
8	.0332	2.0	1.1	1.1	0.64
10	.0406	2.4	1.4	1.4	0.80
12	.0478	3.0	1.7	1.7	0.98
15	.0708	3.6	2.0	2.0	1.15
18	.0845	5.2	2.9	2.9	1.71
20	.0937	6.2	3.5	3.5	2.03
24	.14.52	6.9	3.9	3.8	2.26

TABLE III.—Quantity and Cost of Cement in Deep Sockets, Overfilled Joints (Fig. 5).

Diam. pipe, ins.	Contents, cu. ft.	Cost in cents. Portland cement. Neat.	Portland cement. 1 to 1.	Rosendale cement. Neat.	Rosendale cement. 1 to 1.
4	.0346	2.54	1.43	1.43	0.83
5	.0400	2.94	1.65	1.65	0.96
6	.0557	4.10	2.30	2.30	1.34
8	.0762	5.60	3.14	3.14	1.84
10	.0926	6.80	3.82	3.82	2.26
12	.1093	8.05	4.51	4.51	2.64
15	.1003	11.75	5.62	5.12	3.86
18	.1905	14.00	7.87	7.87	4.60
20	.2407	17.70	9.93	9.93	5.80
24	.3312	24.30	13.65	13.65	8.00

TABLE IV.—Quantity and Cost of Cement in Standard Sockets, Flush Joints (Fig. 2).

Diam. pipe, ins.	Contents, cu. ft.	Cost in cents. Portland cement. Neat.	Portland cement. 1 to 1.	Rosendale cement. Neat.	Rosendale cement. 1 to 1.
4	.0045	0.33	0.18	0.18	0.11
5	.0054	0.40	0.22	0.22	0.13
6	.0065	0.47	0.27	0.27	0.15
8	.0080	0.58	0.33	0.33	0.19
10	.0100	0.73	0.41	0.41	0.24
12	.0140	1.02	0.57	0.57	0.34
15	.0220	1.60	0.90	0.90	0.53
18	.0270	1.97	1.10	1.10	0.65
20	.0300	2.19	1.23	1.23	0.72
24	.0350	2.56	1.43	1.43	0.84

TABLE V.—Quantity and Cost of Cement in Standard Sockets, Overfilled Joints (Fig. 3).

Diam. pipe, ins.	Contents, cu. ft.	Cost in cents. Portland cement. Neat.	Portland cement. 1 to 1.	Rosendale cement. Neat.	Rosendale cement. 1 to 1.
4	.0113	0.82	0.46	0.46	0.272
5	.0134	0.98	0.54	0.54	0.323
6	.0195	1.43	0.80	0.80	0.47
8	.0315	2.29	1.29	1.29	0.729
10	.0393	2.86	1.61	1.61	0.947
12	.0479	3.49	1.96	1.96	1.15
15	.0640	4.67	2.62	2.62	1.54
18	.0877	6.40	3.58	3.58	2.11
20	.1443	10.53	5.91	5.91	3.47
24	.1700	12.41	6.97	6.97	4.10

TABLE VI.—Cost per Cubic Yard in Dollars of Different Mixtures of Mortar with Portland Cement at $2.50 and Rosendale at $1.25 per Barrel and Sand at $1.50 per Cubic Yard.

Kind of mixture.	Portland cement. Cement.	Sand.	Labor.	Total cost.	Rosendale cement. Cement.	Sand.	Labor.	Total cost.
Neat	19.30	...	0.50	19.80	10.55	...	0.50	11.05
1 to 1	9.70	0.92	0.50	11.12	5.12	0.91	0.50	6.53
1 to 2	6.28	1.19	0.50	7.97	3.24	1.17	0.50	4.91
1 to 3	4.63	1.31	0.50	6.44	2.36	1.26	0.50	4.12
1 to 4	3.63	1.37	0.50	5.50	1.88	1.34	0.50	3.72

trestle, etc. The stock house is of brick, with wooden roof trusses carrying a slate roof, and is cut off from the mill by a fire wall. The buildings were erected by the Standard Construction Co., of Easton, Pa. The main buildings include a building 507 ft. long and 92 ft. wide, of which the kiln room occupies 75 ft., the mill room 128 ft., and two stock rooms, 128 ft. each, separated by a packing room, 48 ft.; there is also the boiler house, 36×44 ft.; offices and laboratory, 24×60 ft.; barrel-making house, 60×80 ft.; and machine and woodworking shop, 32×60 ft. The plant includes six Westinghouse engines, aggregating 500 HP., including one of 300 HP., driving nine grinding mills (5 working on the raw material and 4 on the clinker), one of 35 HP. for the machine shop and electric lighting dynamo, and four of 5 HP. each for the kilns; two Heine water-tube boilers, rated at 250 HP. each, but which can easily be worked at 300 HP.; Clayton air compressor, water and oil pumps, etc. The coal is dropped from hopper-bottom cars on a trestle at the back of the boiler house, the trestle having heavy timber stringers resting on concrete piers. In the testing room are a Fairbanks and a Riehle testing machine.

The cement, which is known as the Alpha Portland cement, is largely used in buildings and architectural work, for floors and pavements, etc., and is being used on the foundations of a new bridge at Easton. In the new Bourse Building, at Philadelphia, Pa., the foundations are laid in concrete composed of 1 part Alpha Portland cement to 3 parts sand and 6 parts stone, and the same cement is being used in the walls, floors, etc., about 20,000 barrels in all being required. It has been used also in the Mercantile Club, the Union League Club extension, the Philadelphia & Reading R. R. terminal, and other large buildings in Philadelphia; as well as for the Morgan Building, at Buffalo, N.Y., the new shops of the Pittsburg Locomotive & Car Works, at Pittsburg, Pa., and in numerous smaller buildings in Pennsylvania, the New England States, etc. The general agents for the company are Wm. J. Donaldson & Co., Betz Building, Philadelphia, Pa.

TESTS OF TIGHTNESS OF CEMENT JOINTS IN VITRIFIED PIPE SEWERS.

In our last issue an article with the above heading appeared, from which, owing to an oversight at the composing rooms, a number of tables were omitted, while the article was being made up into pages. The article recounted a series of experiments made by Mr. Freeman C. Coffin, of Boston. The tables omitted are given herewith. Table I. is a log of the tests, and is self explanatory. Tables II. to V., inclusive, show the quantity and cost of Portland and Rosendale cement for different forms of joints. Table VI. relates to the cost per cubic yard of different mixtures of mortar with Portland cement, at $2.50 and Rosendale at $1.25 per barrel, and sand at $1.50 per cu. yd.

NOTES FROM RECENT WATER-WORKS REPORTS.

The cost of laying water mains, at Washington, D. C., during the year ending June 30, 1893, is given in the last report of the Engineer Department of the District of Columbia, as follows:

Size, ins.	Lin. ft.	Cost per ft., cents. Material.	Labor.	Total.
3	3,017	26.42	21.84	48.26
4	8,671	29.57	20.10	49.67
6	51,908	51.42	23.22	74.64
12	6,473	108.10	33.26	141.36

The materials for the above work were generally secured by contract, but the labor was hired by the district. The figures do not include cost of relaying pavements, which ranged from 6.29 cts. per lin. ft. for trap rock, to 54.41 cts. for sheet asphalt, block asphalt being higher yet, partly due to the small lengths involved, never more than 60 ft. Relaying brick cost from 6.36 to about 9 cts., cobble from 9 to 10 cts., and macadam some 16 cts. per lin. ft. The diameter of the pipe had little to do with the cost of relaying pavements. The legal working day in Washington is only eight hours' long. Capt. Chas. F. Powell, Corps of Engineers, U. S. A., is Engineer Commissioner of the District of Columbia.

At the close of 1893 there were under construction for the Philadelphia water-works six pumping engines, with a combined capacity of 137,000,000 gallons. Until June 5 the total pumping capacity available was about 210,000,000 gallons, and during the rest of the year 230,000,000 gallons. The average daily pumpage during 1893 was 179,048,594 gallons, or 150 gallons per capita, against 143 gallons in 1892, and 72 gallons no farther back than 1885. In eight years the water pumped has increased, in round numbers, from 25 to 65 billion gallons, or 160%, and the average per capita consumption over 100%, while the revenues have increased only 46%. Mr. John L. Ogden, Chief of the Bureau, writes of this increase in consumption, in part, as follows:

> New York, a large manufacturing city, uses but 90 gallons per capita; Boston, on the Cochituate supply, only 89.3. If we could reduce our consumption to the same figures as these cities, we would save half the cost of the coal; have ample storage reservoirs and the reservoirs full; could keep one-half of our steam plant in

reserve, and not require any addition thereto for several years; the pressure in the mains and supply pipes would be increased; the water rise higher in the buildings, and low water in the river would not cause any anxiety.

The report of the Louisville Water Co. for 1893 contains an account of a test of a 16,000,000-gallon pumping engine designed by Messrs. E. D. Leavitt and Charles Hermany. The main features of the test were given in Engineering News, for Dec. 13, 1894.

The city of Yonkers, N. Y., now has all services metered, except those supplying water for public purposes and for the use of builders. The water commissioners adopted the full meter system by a resolution, which took effect June 1, 1892. Mr. Jos. A. Lockwood, Superintendent, states in his last report that after 15 years of experience in supplying water by fixture and frontage charges and by meter, the absurdity of the first and the justice of the second method were realized, and the full meter system adopted.

It is a rare thing for an engineer, in reporting on improvements in a city's water supply, to recommend the adoption of meters. Such a recommendation was recently made to the water-works committee of Fort Worth, Tex., by Mr. John B. Hawley, Consulting Engineer. Mr. Hawley estimates that the 2,300 services of the city could be metered at an average cost of $16 each, or $36,800, reducing the average daily consumption from 4,000,000 to 2,500,000 gallons.

Mr. Hawley also recommends the building of a storage reservoir, at an estimated cost of $131,000, or if this cannot be done that small dams be built on the streams now supplying the city, that a 2,000,000-gallon mechanical filter plant be put in to clarify some of the worst water, and that the artesian well connections be lowered 12 or 13 ft. Experiments made at two of the artesian wells indicated that by such a lowering the flow would be doubled, but Mr. Hawley was not sure that the increase would prove to be permanent. The pipe now connecting the wells is of cast iron, 8 to 36 ins. in diameter. Mr. Hawley estimates that 12-in. vitrified pipe would serve the purpose just as well, as the present conduits are far too large and are not under pressure, and that the old iron pipe could be sold at a price which would go far towards paying the cost of vitrified pipe and of lowering the conduits.

The report on the sewerage and water supply of St. John, N. B., for the year 1893-4 is notable as being the last one made by the late Mr. Gilbert Murdoch, M. Am. Soc. C. E., who was superintendent of these works from their inception, in 1850, until his death, in May, 1894. In his reports, Mr. Murdoch has put on record the most important events and figures connected with each year's work, giving much information of value both locally and to all outsiders interested in water-works and sewerage. In many respects these reports have been models of their kind.

The amount realized at Montreal in 1893 from the sales of water by meter measurement was at the average rate of 20.2 cts. per 1,000 gallons, against 9.4 cts. for that sold at fixture rates. Mr. A. Davis is superintendent, and Mr. J. O. Alfred Laforest is assistant superintendent of the water-works.

THE COUNTERBALANCING OF LOCOMOTIVES.

A most important subject, in regard to the efficient performance of locomotives, which is now being extensively investigated by mechanical engineers, is that of the proper counterbalancing of the reciprocating and revolving weights of the wheels and driving mechanism, so as to ensure ease and steadiness in riding and to prevent uneven and severe strains upon the rails. A large part of the investigation has been devoted to the proper counterbalancing of engines built in accordance with existing plans, but a no less important part is that which has reference to reducing the weights of the reciprocating parts so as to reduce the amount of counterbalance weight required. There is but little approach to uniformity in this respect, and, as noted below, nearly 20 different rules are in extensive use, and are all claimed to be satisfactory by those who use them. Even this is not the limit, for carelessness and error in applying the rules, variations imposed by peculiarities in the design of engines, and alterations made subsequently (intelligently or otherwise) lead to the greatest possible variation from any attempt at uniformity. Two papers on this subject have been given in our issue of April 26, 1890, and Feb. 22, 1894. In the present article we give abstracts of three recent papers on this subject, the first two of which were presented at the December meeting of the American Society of Mechanical Engineers, and the third at the November meeting of the Southern and Southwestern Railway Club.

The first paper was one on "Rail Pressures of Locomotive Driving Wheels," by Mr. D. L. Barnes, of Chicago, which opened by a discussion concerning the effect of equalizing levers in distributing the weights on the several wheels. The author considers that equalizers are not really necessary where the track is smooth and level, and that they have little effect on the weights per wheel at high speeds, since the velocity of the wheels over the track at high speeds is so great that there is not time for the wheels to drop down into a depression or to follow down the depression of a weak joint or unsupported section of a rail. We are inclined to doubt, however, whether any extent of track is so perfect as to make the use of equalizers inadvisable; and as practically every locomotive has to travel during its service over various qualities of track and at various

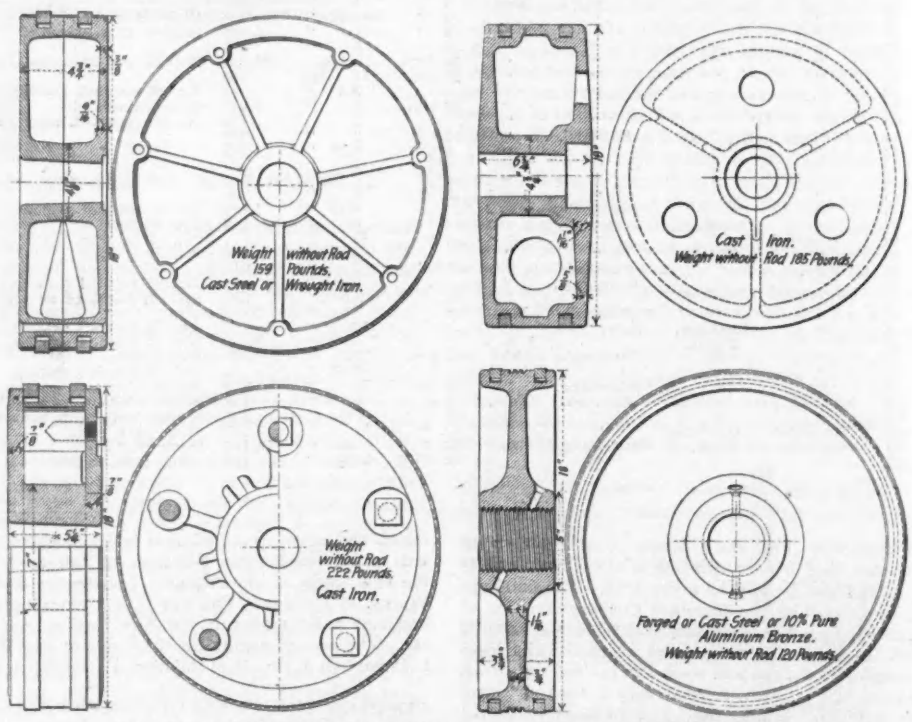
Weight without Rod 159 Pounds. Cast Steel or Wrought Iron.
Cast Iron. Weight without Rod 185 Pounds.
Weight without Rod 222 Pounds. Cast Iron.
Forged or Cast Steel or 10% Pure Aluminum Bronze. Weight without Rod 120 Pounds.

FIG. I. FORMS OF LOCOMOTIVE PISTONS IN COMMON USE.

speeds, it does not seem advisable to consider the omission of the equalizing system, nor is it probable that it will be considered by practical men in this country. The following are extracts from Mr. Barnes' paper:

As a locomotive goes along a track the driving wheels rise and fall according to two conditions: 1, the depth of the depressions and rises; 2, the speed. The faster the speed, the less will be the rise and fall, unless the wheel gets into a vertical oscillation owing to regularity and succession of the depressions and rises. Vertical oscillations, because of such regularity, probably seldom occur. To mount over a rise increases the pressure on the track in the same way as when the driver is rising out of a depression. From this it is clear that the weight on the driving wheels at high speeds is a variable quantity, depending little on the equalizers, and mainly on the speed, stiffness of springs, inertia of the mass of the wheels, and greatly upon the weight of the reciprocating parts.

Rail pressures for the main drivers are affected by the angularity of the connecting rods. For locomotives running ahead the rail pressures are increased by the push and pull of the connecting rods, but for locomotives running backward the rail pressures are decreased by the same action. It is evident that the weight of locomotive drivers on the rails, as measured by track scales, is only the normal weight, and is but little indication of the maximum rail pressures.

In the counterbalancing of locomotives it has been found that from one-third to one-half of the weight of the reciprocating parts need not be balanced, although on some railways it is customary to balance all reciprocating weights. The roughness of locomotive service permits a decrease of the balance for reciprocating parts of at least one-third, without causing disagreeable longitudinal oscillations and lateral motions of the engine. Some interesting information about this matter has been presented to this Society by Prof. Gaetano Lanza. (Trans. Am. Soc. M. E., Vol. X., p. 302.) The balancing of the revolving weights should be complete, and this is done in the ordinary way of balancing flywheels.

One fact that has been determined by practical experience is that, so far as the locomotive itself is concerned, the balancing is practically perfect when the balances are placed in the wheels opposite the crank pins, and when all of the revolving parts are balanced and not more than 100 lbs. of reciprocating parts for light engines and 300 lbs. for heavy engines are left unbalanced. When scientifically analyzed, this method of balancing is found to be imperfect, and such analysis shows that the balancing would be more exact if the counterweights were placed not quite opposite the cranks, and if an additional balance to counteract the effect of the balances on the opposite side was placed in each wheel at right angles with the crank, but in practice such a plan prevents the duplication of the wheels, and gives no better results than the simpler plan commonly followed, that is, if the reciprocating parts be not unnecessarily heavy. The effect of putting in the additional counterweight is to increase the maximum rail pressure, which is too great under the simpler plan of counterbalancing, and, therefore, the additional balance would better not be used unless for locomotives already constructed, where the fundamental design is bad, and such balance is added for correction of existing evils.

The practical problem of balancing is not one of "how to balance," but of reducing the total weight of the reciprocating parts to a minimum. What can be done in this way to improve locomotives is indicated by what has been done in decreasing the weight of pistons, cross-heads and main rods. These parts on American locomotives are generally heavier than are necessary for the service, and a reduction of one-half in weight is possible in many cases. The average possible reduction may be taken as 40% for all designs. An example of what can be done and what has been done is found in Fig. 1, which shows pistons in common use for the same size of cylinder. The weight of the lightest is but 54% that of the heaviest. Even more striking examples of reductions can be found in cross-heads and main rods. It is only within the short time since high maximum speeds have become common practice that the effect of heavy reciprocating parts has been such as to

call attention to the need for reductions in weights. Now bent rails and damaged track reports are too common to permit further neglect of a proper consideration of the weights of reciprocating parts.

No doubt heavy locomotives injure the track more than lighter ones because of the greater weight, but it is by no means certain that the heaviest consolidation engines, or engines having great weight per wheel, when run at moderate speeds, injure the track as much as lighter locomotives when run at high speeds; yet, if the heavier locomotive was run at the same high speeds with equal weight of "excess balance," the effect would, of course, be worse. The point of this is, that when track is damaged, particularly at the foot of grades, the cause may not always be found with the heavier locomotives having the greatest weight per wheel, but is more likely to be found with those engines having small wheels and heavy reciprocating parts, where the number of revolutions per minute is high, although the speed may be moderate.

An important example of damaged track caused by light engines is one that occurred in 1893 on a line where there are engines with weights per wheel varying from 13,000 to 18,000 lbs., the types being eight-wheel, ten-wheel and consolidation. The damage was caused by the lightest type of engine running at an excessive speed on a down grade. In another case a light eight-wheel engine was run without rods in a freight train at 50 miles an hour, and the result was two miles of badly damaged track and two broken bridge rods. In another case a consolidation engine was broken down on one side and the rods were taken off on that side and the engine was run faster than schedule speed to make up time. The effect was several miles of bent rails. The bends are seldom noticeable unless they are as much as ⅛ in. Occasionally the bends are as much as 1 in. vertically and ½ in. horizontally inwards toward the center of the track, the horizontal bending being undoubtedly due to the fact that the rail is supported on the bottom flange and the load is applied on top, and generally nearer the inner than the outer edge.*

Contrary to what one might suppose from the extent of the discussion, there is nothing to prevent a practically perfect counterbalancing. Theoretically it is not possible to exactly counterbalance the reciprocating parts of a locomotive with a balance revolving in the wheel, but practically the weight of the locomotive is so great in proportion to the forces remaining unbalanced that the engine is not more shaken than can be permitted. To keep a locomotive in perfect balance, the center of gravity of the whole machine must remain in the same position longitudinally and vertically at all times, but this can only be when the parts are moving in such a way as not to disturb the center of gravity. If one part moves ahead, another part of equal weight must move back an equal distance with the same velocity at all times; that is, when the two parts start from the same point. But if the parts start from different points the weights or the velocities must be different; that is to say, the parts must always so move that the center of gravity is unchanged. If the reciprocating parts are heavy and the engine is light, the unbalanced forces may be greater than can be permitted, but as engines are now built and balanced the result is practically perfect so far as the locomotive is concerned.

The effect on the track depends little upon the method adopted for counterbalancing, and is almost wholly fixed by the weight of the reciprocating parts. In any given locomotive there can be unbalanced forces without shaking the engine too much, and the amount of the unbalanced force that can be permitted depends upon the gross weight, and, also, somewhat upon the length of the engine. The longitudinal shaking, called "plunging," is not affected by the length of the engine, but the lateral shaking, called "nosing," is generally less with long engines than with short ones, as the inertia of the locomotive and the moment of the resistance of the friction of the drivers to lateral slipping are greater.

If the cranks on opposite sides of the engine could be placed at the same angle; that is, both ahead or back at the same time, there would be no tendency to "nosing," as the forces that produce it would balance. When the cranks are at 90° the maximum tendency to "nosing" occurs at the different points of revolution on the two sides. This is true of the steam valve inertia as well as the inertia of the reciprocating parts. When the cranks are at 180°, the resultant force which produces "nosing" is, in the main, doubled, and, so far as "nosing" is concerned, it is easier to balance locomotives having two cranks when the cranks are at 90° than when at 180°.

Owing to the fact that the counterbalances in locomotive drivers are not in the same plane vertically as the crank pins and rods which they balance, there is a resultant turning force, tending to turn the locomotive laterally or cause "nosing."

Perfection of counterbalance of reciprocating parts is not only unnecessary, but quite undesirable, as it increases the effect of the counterbalances on the track. The part of the counterbalance which affects the track is not that part which is used for the revolving weight, as that is balanced in all positions by the revolving parts. It is the part that is used for the reciprocating parts, and known as the "excess balance," that injures the track, as its centrifugal force is counteracted only horizontally. Vertically this part of the counterbalance is free to lift the wheel from the track or increase the pressure on the rail, and this is the only reason why it is very desirable to use as little counterbalance for the reciprocating parts as possible. If all counterbalance for reciprocating parts is omitted, the effect is to cause "plunging" and "nosing." With a given weight of unbalanced reciprocating parts and a given speed, the lighter the engine the greater will be the oscillation, both in "nosing" and "plunging." The heavier the locomotive, the less will be the percentage of reciprocating weight that needs to be counterbalanced. The limit of the counterbalance that must be used for reciprocating parts is found when the oscillations are not too disagreeable for the engineman and fireman, and for the mail clerks in the postal cars, which are usually run at the head of the train. The "plunging" oscillations are the only ones that affect the cars, and these, even in rather extreme cases, do not extend farther than the third or fourth car from the engine.

The effect of the "excess balance" is peculiar, and has been studied by mathematical analysis in a limited way and by chalking the track and running a locomotive over at high speed. In such cases it has been found that the drivers lifted from the track. The distances between the depressions of the rails correspond nearly with the circumference of the driving wheels. The same effect is produced to a greater extent when locomotives are hauled over the road at fast freight speeds with the rods removed. In such cases nearly all of the counterbalance weight becomes an "excess," and is to be treated just as an "excess balance" for reciprocating parts. Damage to the track from this origin has caused orders to be issued on some roads that locomotives without rods shall not be hauled at a speed exceeding 20 miles an hour. Prof. Goss, at Purdue University, has shown very clearly that locomotive drivers lift from the track at high speeds.

It was proposed by the Master Mechanics' Association in 1886 (Proceedings, p. 156) that an apparatus be constructed for measuring the effect of the "excess balance," and drawings were made, but the machine was not built. The inefficiency of any such apparatus appears from the fact that when strong enough to withstand the shock,. its weight would be so great that its inertia would destroy the accuracy of the record. In dynamometer car work, the car is placed next to the locomotive, and the oscillation longitudinally due to the unbalanced portion of the reciprocating parts, even on what are considered to be well-balanced engines, is distinctly visible on the diagram. The effect of the oscillations is to cause a variation of the recording pencil, which corresponds with the revolutions of the drivers. This small oscillation is neither disagreeable to the engineman and fireman nor detrimental to the locomotive. To get perfection of counterbalance, locomotives have been hung up on chains clear of the track, and have been run at high speed. A pencil attached to the front of the engine describes an ellipse in a horizontal plane with an axis inclined to the center of the locomotive. It is possible to add sufficient balance, and so locate it as to reduce the amplitude of the vibrations in a horizontal plane to a very small amount, but such perfection is not necessary in practice, and is not desirable, as it requires more "excess balance," and the bad effect on the track is increased.

While it is true that a counterbalance travels, with respect to the surface of the earth, in a path that resembles a cycloid, and is, in fact, a trochoid, yet with respect to the engine, the counterbalance travels primarily in a circle, and only varies from that path with respect to the engine when the rail deflects or the driver lifts from the rail. It seems hardly necessary to say, that in making calculations about the effect of the counterbalance, either on the track or on the locomotive, the trochoidal path with respect to the surface of the earth need not be taken into account.

The centrifugal force of the counterbalances acts practically over the rail line, but the centrifugal force of the revolving parts, and the inertia of the reciprocating parts, act outside of the rail line. The resultant of these forces tends to revolve the engine, first in one direction, and then in the other, and thus cause "nosing."

In regard to variations in rail pressure due to vertical oscillation of the driving wheels, Prof. Lanza, in 1886, after a brief consideration of a specific problem, submitted to him by the writer, gave the opinion that the maximum and minimum rail pressures did not occur at the upper and lower positions of the counterbalance. The first useful information for a solution of the problem was gathered in 1891 by the late Prof. Arthur T. Woods, who made an experiment with a model under assumed conditions, the results of which showed that under those conditions the maximum and minimum rail pressures did not take place when the counterbalance was directly up or down. These results were given first in the "Technograph," 1891, and afterwards in the "Railroad Gazette," Aug. 14, 1891, p. 500. In 1893 Prof. W. F. M. Goss, of Purdue University, consented to determine from his test locomotive some fundamental facts about the revolution of a locomotive driver, and he devised the plan of putting an iron wire between the driver and the carrying wheels to learn where the driver left the rail and where the pressure was greatest. The results showed that the maximum lift and maximum presssure did not occur when the counterbalance was directly up or down, and, further, that succeeding revolutions did not give duplicate results. This last Prof. Goss attributed to the fact that the engine rolled sidewise on the driving springs, and so varied the pressure on the rail.

The effect of the "excess balance" on tire wear must be considerable when the revolutions per minute are as great as they are with large drivers at very high speeds and small drivers at moderate speeds. It has been shown both mathematically and by the results of the practical experiments at Purdue, that with drivers of ordinary diameter the tires are off the track for a considerable portion of a revolution at 60 miles an hour, when the "excess balance" is about the ordinary amount. Omitting the wear of brakeshoes, which ordinarily do not wear the tire where it bears upon the rail, it is evident that if the average locomotive should be continuously run at 70 miles an hour there would be one point on the tires, except the main tire, that would never touch the rail, and would therefore never be worn. The main wheels do not lift as much as the back wheels; that is, when running ahead, for the reason that the obliquity of the main rods causes a downward pressure on the track, which counteracts somewhat the lifting tendency.

In looking for the causes of flat spots on driving tires of fast-moving locomotives, the first point of importance is to find the part of the revolution where there is the least wear. This point will generally be found following the crank; that is, at a point where the tire touches the rail when the crank has passed the 90° point or lower quarter, the engine running ahead, that being the place where the driving wheel will probably most frequently have the maximum lift. An examination of worn tires of high-speed locomotives shows this to be the case. There are causes of tire wear other than the abrasion due to rolling contact, the principal cause being the slipping of the tires in starting up a heavy train. The "imperceptible slip" which has been said to exist has never been proved to take place after the engine has reached an ordinary speed, say, of 10 miles an hour, but it occurs sometimes at slow speeds when the engineer is quite expert in handling the throttle. It can be seen when a heavy train is being started and the locomotive is moving at less than five miles an hour. It is due to the non-uniformity of the moment of rotation produced by the steam pressure on the pistons. The maximum moment when the slipping occurs is slightly greater than the adhesion of the drivers, and for a few degrees of revolution the drivers slip slightly. However, locomotives are not generally run in this way, for the reason that when the balance between the moment of rotation and the moment of adhesion is so delicate, the change in the coefficient of friction, caused by a slippery place on the rail, permits the engine to slip violently. For various reasons, enginemen are required to avoid this. Instructions are generally given to slip the drivers as little as possible. The writer made experiments in 1891 on a heavy grade 17 miles long, of about 117 ft. per mile, on the Baltimore & Ohio R. R. ("Railroad Gazette," Nov. 27, 1891, page 832), to determine whether, under the extreme conditions of hauling a heavy load, there was any slip after starting. The results showed that the drivers made the same number of revolutions when going up the hill with a heavy train as when coming down without load.

Tires wear both by pulverization of the steel due to rolling contact and by abrasion, and, as the points of maximum wear of each kind do not always coincide, it is difficult to predict where the most worn places will occur, unless all the conditions of speed and service are accurately known. The maximum rail pressures occur with greater uniformity for back drivers than for main drivers, for the reason that the vertical component of the piston pressure due to the angularity of the connecting rod varies with different cut-offs and modifies greatly the points of maximum rail pressures. It is only in cases where locomotives are run quite uniformly in speed and piston pressure that it is of

* Some cases of such bending of rails were noted by correspondents in our issues of Feb. 15 and March 22, 1894.

any practical use to examine the relation of the positions of points of maximum rail pressure and the points of maximum wear.

Conclusions may be presented as follows:

1.—The present method of counterbalancing locomotives by providing in each driver a balance sufficient to fully counterbalance all the revolving parts and an additional balance, known as the "excess balance," which has a centrifugal force equal to about two-thirds of the maximum inertia of the reciprocating parts, is practically perfect so far as the locomotive itself is concerned.

2.—The "excess balance" now generally used for the reciprocating parts and counteracting about two-thirds of the maximum inertia of those parts, is too great for speeds above 65 miles an hour, with drivers less than 6 ft. in diameter, as the track is liable to be damaged by the excessive rail pressure that it causes.

3.—The only practical way in which the "excess balance" can be reduced is by reducing the weight of the reciprocating parts, and as these parts are generally made heavier than the service demands, it is possible to reduce the "excess balance" to a point where the rail pressures will not be destructive, provided that the diameter of the drivers be made suitable for the speed.

4.—The larger the driver for the same speed and weight of reciprocating parts, the less will be the maximum rail pressure caused by the "excess balance."

5.—The heavier the locomotive, the greater is the amount in pounds of the reciprocating parts that can remain unbalanced without causing the locomotive to shake, in "nosing" and "plunging" more than can be permitted. It is not the percentage of the total weight of the reciprocating parts that should be considered in selecting the "excess balance;" it is the actual weight in pounds that can remain unbalanced without shaking the engine too much. If one-third of the weight of reciprocating parts weighing 600 lbs. can remain unbalanced, then, if those parts be reduced to weigh but 400 lbs., one-half can remain unbalanced, and "excess balance" will be needed for but 200 lbs. instead of 400 lbs. of reciprocating weight.

6.—The maximum rail pressure of a driving wheel is not at all indicated by the static load of the wheel on the rail. The impressed load due to the "excess balance" is often double the static load, and the pressure at the point of impact when the wheel lifts from the rail and drops is even greater. There appears to be no way of determining what the impact pressure is, but the impressed load due to the "excess balance" can be calculated by the formula for centrifugal force. About all that is known about the impact pressure is that it is enough at times to bend a 70-lb. rail downward vertically 1 in. in cases where the engine has small wheels and is run too fast, or has the rods taken off and is run at moderately high speeds or has improper counterbalances.

7.—The speed at which any given driver will begin to lift from the rail is probably less than that at which the centrifugal force of the counterbalance equals the pressure of the wheel upon the rail, as at speeds lower than that the wheel has small vertical oscillations that may carry it off the rail. But the lift will not be important until the speed has increased to a point where the centrifugal force of the "excess balance" is somewhat greater than the pressure of the wheel on the rail.

8.—The exact height of lift of a wheel in any given case is dependent upon so many unknown and variable quantities in practice, such as the flexibility of the track and the rhythm with which points of equal flexibility succeed each other in the direction in which the locomotive is running, that it is impossible to predict what it will be. But it is sufficient to know that for the good of th track, and to prevent broken and bent rails, and for the safety of the train following a locomotive, it is not prudent to run a driving wheel at a speed where the centrifugal force of the "excess balance" exceeds the pressure of the wheel upon the rail.

9.—All driving wheels for fast locomotives should be as large in diameter as it is possible to make them, and not decrease the power too much in starting trains.

10.—The path of the center of gravity of a wheel, with respect to the engine during a revolution, is an oval figure with the long axis more nearly vertical than horizontal, the inclination of the axis varying constantly, owing to the difference in the elasticity of the track at different points, and to other causes.

11.—The heavier the driving wheel and the parts under the driving springs, and the stiffer the driving springs, the less will be the lift from the rail, all other conditions being equal.

The second paper was by Prof. W. F. M. Goss, on "An Experimental Study of the Effect of the Counterbalance in Locomotive Driving Wheels upon the Pressure Between Wheel and Rail," the experiments being made with the eight-wheel locomotive in the engineering department of Purdue University, which plant was described in our issue of May 19, 1892. This plant was burned in January, 1894, but has since been rebuilt on a more complete scale. The special feature of interest in these tests was the method adopted for recording the pressures by means of the degree of compression of a soft iron wire passed between the driving wheels and the supporting wheels representing the rail. It was shown that, under certain conditions, the driving wheel actually lifted from its support. We quote from the paper as follows:

The apparatus employed consisted chiefly of the Purdue locomotive "Schenectady," which, as is generally known, is mounted with its drivers resting upon wheels of approximately the same diameter with the drivers. When the drivers are turned by the engine, the supporting wheels roll in contact with them, the engine as a whole remaining stationary. To guide the wire which was to be fed under the driver, a length of ⅝-in. gas-pipe was secured to the laboratory floor in front of each driver included in the experiment. Three pipes were thus arranged. A deflector plate was fixed behind the main driver, to turn the wire delivered from this wheel away from the rear driver;

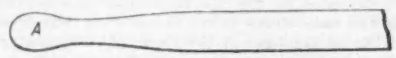

Fig. 2. Shape of End of Test Wire.

but, except for this plate, no attempt was made to control the course of the wire after it left the wheel. The wire was of common annealed iron about 0.037 in. diameter, carefully straightened, and cut into lengths of 20 ft.; that is, about 3.5 ft. longer than the circumference of the drivers, and 2 ins. longer than the guide pipe in which the lengths were to be fed to the wheels. Wires thus prepared were laid in light wooden troughs to preserve them from injury, and a trough thus supplied was placed in line with each guide pipe. In conducting the experiments, an operator at each pipe drew a wire from the trough and passed it into the pipe until only about two inches of the length remained outside. From the relative length of guide tube and wire, it was known that the opposite end of the latter was now close to the driver. When desired conditions of speed had been secured and a signal given, a touch of the operator's finger upon the end of the wire was sufficient to start the opposite end under the wheel. The starting of the wire was accomplished without commotion, the man in charge being conscious only of having touched it. The initial end of each wire was, in plan, of the outline shown by Fig. 2, from which it would appear that when the wire came under the influence of the wheel's motion, the tensional stress upon sections near the end, as at A, exceeded the elastic limit of the material, this stress being required to impart motion to the mass of wire to the right of A. The weight of the 20-ft. length was about 1 oz., and the time occupied in its

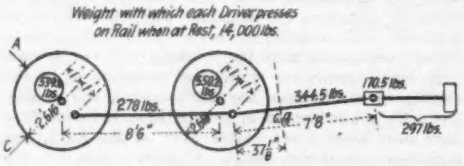

Fig. 3. Weights of Revolving and Reciprocating Parts of Purdue Locomotive.

passage was usually 1-5 second. These facts will help to show the significance of the speeds used in the experiments.

The speed of the locomotive was noted from a registering counter, and also by a Boyer speed recorder, a permanent record being obtained from the latter instrument. To assist in connecting the effect produced on the wire with definite phases of the wheel's motion, a nick was made with a sharp chisel across the face of each driver, in line with the counterweight, as at A, Fig. 3. An impression of this nick was sharply defined upon every wire that passed under it. The initial end of the wire could, as has been already stated, be determined by an examination; but to leave no doubt as to this matter, and for the purpose of giving a second reference point, one of the wheels was marked with two parallel lines 90° from the first reference line, as at C, Fig. 3.

It was found by a comparison of reference marks that distances along the length of the wires could be taken as representing equal distances around the face of the wheel. Thus, the length of each wire being greater than the circumference of the wheel, it would sometimes happen that a single wire would receive two impressions from the reference mark; the distance between the two points thus impressed upon the wire was found to be equal to the circumference of the wheel. This fact made it easy to connect effects left upon a wire with the wheel positions (crank angles) producing them.

Many of the wires that have been produced by the experiment described have since been carefully calipered at 5-in. intervals, the results plotted, and a smooth curve drawn through the points thus located. Some of the results thus obtained are presented as Figs. 4, 5 and 6, the points representing the actual thickness of the wires being designated by means of small circles. It will be seen that all diagrams are plotted with reference to definite wheel positions.

The engine as delivered by its builders was balanced for the road; but to increase its steadiness in the laboratory, weights were afterward added in equal amounts to the several wheels, until a full horizontal balance had been secured.* The revolving and reciprocating parts which required counterbalanceing, exclusive of the crank-pins and crank-pin bosses which are assumed to be parts of the wheels themselves, were found to weigh as follows:

	Lbs.
Piston and piston rod	297.0
Cross-head with part of indicator rigging attached	170.5
Main rod	344.5
Side rod	278.0
Total for one side	1,090.0

The corrected net weight of counterbalance available to balance the revolving and reciprocating parts acting upon the crank-pins is 550.2 lbs. in the main wheel and 539.8 in the rear wheel.

The weights of the parts involved, together with certain dimensions, are summarized in Fig. 3. Taking the weights of side rod and of main rod as already given, and considering 0.6 of the weight of the latter as a revolving part, the excess of balance over that required for revolving parts alone is 204.5 for the main wheel, and 400.8 for the rear wheel, which shows 66% of the balance for reciprocating parts to be in the rear wheel.

Six different rules for balancing locomotives for the road, reported as being in common use, give weights of counterbalance for the locomotive in question, ranging form 462 to 588 for the main wheel and from 260 to 381 for the rear wheel, or averages of 548 and 350 lbs. respectively. Compared with these several standards, the weights of the counterbalances in the Purdue engine average 0.4% too heavy in the main wheel and 54.2% too heavy in the rear wheel. It is evident, therefore, that the weight of the counterbalance in the rear wheel, from which most of the results about to be discussed were obtained, is in excess of that allowed by good practice as expressed by the rules already given. But practice cannot always conform to the law by which it assumes to be governed. It often happens where wheels are of small diameter, and the connections are heavy, as in mogul or consolidation engines, that there is not sufficient room in the main wheel to get in a counterbalance large enough for the revolving parts alone; in this case, therefore, the balance for reciprocating parts of this wheel must be taken by the other coupled wheels, in addition to that which, under the rules, would be counted as properly belonging to them. By this process, wheels having revolving parts which are relatively light are employed to balance a larger percentage of all the reciprocating weights. Again, almost any eight-wheel engine, balanced in an approved manner, will, if the coupling rod is removed, have an excess of balance in the rear wheel equal to that for the engine under consideration; and such engines are not infrequently run while disconnected.

Attention has already been directed to the fact that in the engine experimented upon the excess of weight in the counterbalance over that required for the revolving parts alone was much greater for the rear driver than for the main driver. As the lifting effect is proportional to this excess of weight, it follows that wires run under the rear driver were likely to show more variation in thickness than those under the main driver. Results of experiments upon this point are shown by Fig. 4, which represents wires obtained at the same instant from the main driver and the rear driver, respectively. It will be seen that wire I. from the main driver shows but slight variation in thickness, notwithstanding the high speed (312 revs. per minute), and it may be said that no wire was ever obtained from this wheel which gave evidence that the wheel had left the track. From mathematical considerations it can be shown that this wheel would not be expected to lift at speeds below 80 miles per hour (428 revs. per minute), and such speeds are not practicable with wheels of the diameter experimented upon.

Passing now to an inspection of wire II. (Fig. 4), from the rear wheel, which was obtained at the same instant with wire I., it will be seen that there is a

* The new plant, now in operation, does not require the locomotive to be in complete horizontal balance.

jump of the wheel just after the counterbalance has passed its highest point, which, when compared with the corresponding movement of the main driver, is very pronounced. Wires from this wheel at higher speeds are shown by Fig. 5. In this figure the full diameter of the wires is in each case shown by a dotted line drawn parallel with the base line. Wire III., made at 59 miles (316 revolutions), shows that there was an instant in the passage of the wire, corresponding to the point A, when it was barely touched by the wheel. Increasing the speed to 63 miles (337 revolutions) increased the lifting action of the wheel to the extent shown by wire IV., Fig. 5. At the point B, the wheel parted contact with this wire and did not again touch it until the point C was reached, an interval of about 40 ins., the portion of the wire between B and C being entirely round and apparently unaffected by its passage under the wheel. A further increase of speed gives, as is shown by wire V., a still greater length of full wire, the distance from D to E being its time of descent changed. Thus, the existence of this vibration makes it impossible to duplicate wires with certainty, even though the speed is constant; its effect is well shown by Fig. 6. Wires VI. and VII. were taken from the rear drivers at the same instant, one from the right side, the other from the left; the speed, therefore, must have been the same for both. The right driver lacked a good deal of leaving its wire, but the left driver was in air for a tenth of a revolution. Again, wires VIII. and IX. were made in the same way at a higher speed, and here, while both drivers were off the track, the results are reversed, the right driver giving the greater length of full wire. It will also be seen from the diagrams that not only is the extent of the vertical movement of the driver modified by the rocking of the engine, but the position of the wheel when such motion occurs is changed. It is evident, therefore, that this movement of the engine upon its springs will prove a serious difficulty whenever an attempt is made to predict as to the precise movement of the

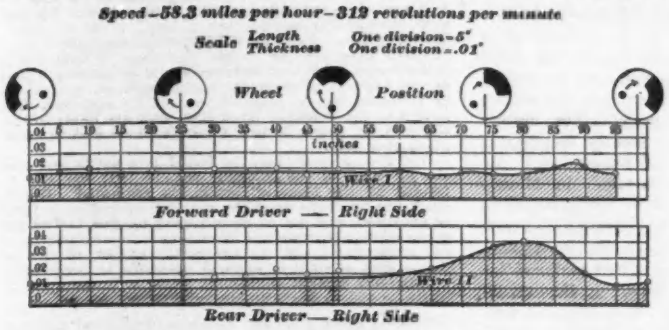

Fig. 4.

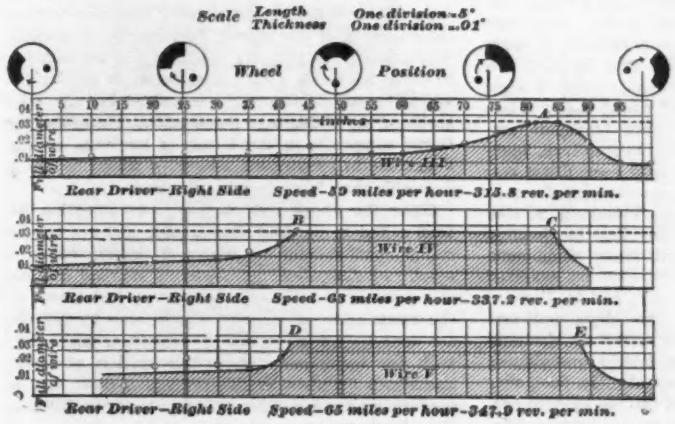
Scale Length One division=5"
Thickness One division=.01"
Wheel Position
Inches
Wire III.
Rear Driver–Right Side Speed–59 miles per hour–315.8 rev. per min.
Wire IV.
Rear Driver–Right Side Speed–63 miles per hour–337.2 rev. per min.
Wire V.
Rear Driver–Right Side Speed–65 miles per hour–347.9 rev. per min.

Fig. 5.

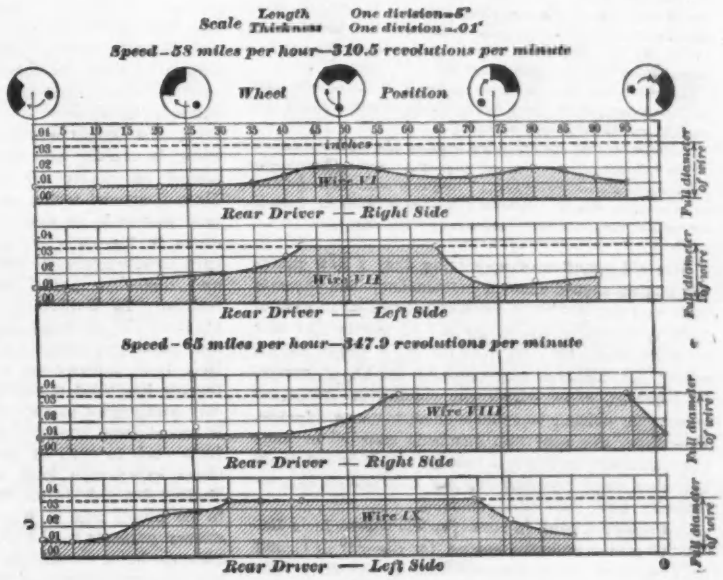

Fig. 6.

DIAGRAMS OF WIRE TEST FOR LOCOMOTIVE COUNTERBALANCES.

very nearly equivalent to a quarter revolution of the driver.

It will be seen that all of these wires (II. to V., Figs. 4 and 5) substantially agree in showing the maximum lifting effect to occur after the counterbalance has passed its highest point, an effect undoubtedly due to the inertia of the mass to be moved; also in showing that the rise of the wheel from the track is more gradual than its descent. The latter condition follows as a sequence of the first.

Portions of the wires not shown on the diagrams do not vary much in thickness. The metal is rolled so thin by the normal pressure of the wheel that further increments of pressure do not greatly affect it. The wires, therefore, do not emphasize the destructive effect of the variation of wheel pressure when the change is insufficient to lift the wheel from the track.

It now remains to mention the effect of certain disturbing elements which are shown by the experiments to modify the actual movement of the wheel, other conditions remaining constant. For the rear wheel, these disturbing elements are all in the nature of vibrations. The first to be noticed is the rocking of the engine upon its springs, which motion tends to vary the pressure of the wheel upon the track independently of the action of the counterbalance. At one revolution the effect of the rocking may oppose the action of the counterbalance, and at the next revolution it may supplement the action of the counterbalance in producing a vertical movement of the driver. Again, the effect of the rocking may at a given instant be nil, and the wheel may rise under the action of the counterbalance; but in another instant the effect of the counterbalance and the path of the wheel while in air is modified and

center of gravity of the driver, whether the method of investigation be mathematical or experimental.

There appears, also, to be a vibration of parts, as, for example, of the wheel as a whole, these vibrations being of small amplitude. Evidence of the presence of such vibration is shown by the location of points on the diagrams of wires, Figs. 4 to 6, which points represent the thickness of the wires as found by measurement. Referring especially to wires I. and II. (Fig. 4), it will be seen that the actual thickness of the wire alternately increases and diminishes with every point. The time involved in passing from one high point to another (a distance of 10 ins.) was about 0.01 second. This vibration may be traced on other diagrams; its amplitude is from 0.002 to 0.004 in. only. Whether the process of introducing the wire starts, or has any connection with, this vibration, the experiment does not show.

A third class of vibrations is made apparent by a duplication upon the wire of the reference mark on the wheel. As has already been stated, a light nick from a sharp chisel was made across the face of the wheel to serve as a reference mark. This nick leaves a clear-cut projection upon the wire. But at high speeds the single nick across the face of the wheel leaves two projections upon the wire, showing that after making one impression the surface of the wheel must for an instant have actually cleared the wire, and then impressed itself a second time. The distance between these projections on the wires varies somewhat, but is usually about ½ in., which represents a time interval between the two impressions of about 0.008 second. The contact between wheel and track is therefore not continuous, but is a succession of exceedingly rapid impacts. These vibrations cannot affect the wheel as a whole; they are doubtless due to the elasticity of the materials, and involve only the parts immediately about the point of contact. The results of the experiments appear to justify the following conclusions:

1.—Wheels balanced according to usual rules (which require all revolving parts and from 40 to 80% of all reciprocating parts to be balanced, the counterbalance for the reciprocating parts to be distributed equally among the several wheels connected) are not likely to leave the track through the action of the counterbalance, and cannot do so unless the speed is excessive.

2.—A wheel which, when at rest, presses upon the rail with a force of 14,000 lbs., and which carries a counterbalance 400 lbs. in excess of that required for its revolving parts alone, may be expected to leave the track through the action of the counterbalance whenever its speed exceeds 310 revolutions per minute.

3.—When a wheel is lifted, through the action of its counterbalance, its rise is comparatively slow and its descent rapid. The maximum lift occurs after the counterbalance has passed its highest point.

4.—The rocking of the engine on its springs may assist or oppose the action of the counterbalance in lifting the wheel. It therefore constitutes serious obstacles in the way of any study of the precise movement of the wheel.

5.—The contact of the moving wheel with the track is not continuous, even for those portions of the revolution where the pressure is greatest, but is a rapid succession of impacts.

(To be continued.)

The Greater Metropolis bill, introduced into the New York Senate by Senator Lexow, on Jan. 2, provides simply for the legal consolidation of the area included in the original project, and the appointment of a commission to report upon a system of equal taxation and valuation of property for this area. For the present, local administration and government of the separate territories interested are to remain unchanged, and all officers are to be elected or appointed as heretofore. The expenses of the commission on taxation are to be paid by the several sections, pro rata, according to the relative value of real property as fixed by the Board of State Assessors for State taxation. The report of the Greater New York Commission, sent in with the bill, says that to disturb or suspend the varied machinery of administration now operating within the area to be united, would inevitably lead to confusion, litigation and possibly damaging consequences. It will require time to intelligently deal with the problem of centering control and responsibility, and for the present the first movement would probably be in the direction of establishing commissions of police and health, having jurisdiction over the whole area in question. There seems to be no insurmountable obstacle to putting this scheme into practice at an early day, and it is suggested that this could be done by joint action of the Mayors of the two great cities and representatives appointed by the minor territories.

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The old practice of specifying that a new pumping engine should show a certain duty and capacity test, and not stating a basis of settlement in case of failure, seems likely to go out of use in the best specifications. On the face of it, a pump falling below the contract requirements would, of course, be rejected, after which the contractor would, of course, be obliged to remove it at his own expense. Doubtless, this provision has been inserted in some specifications; whether it has or not, it is not probable that many pumping engines deficient in duty or capacity have ever been removed.

It is reported that, in recent specifications for a 15,000,000-gallon pumping engine, for the city of Grand Rapids, Mich., it is provided that if the duty falls below 145,000,000 ft.-lbs. at the test, the contractor shall forfeit the cost of sufficient coal to make up the deficiency through a period of 20 years.

In our issues of Aug. 9 and Sept. 13, 1894, we noted specifications for pumping engines at McDonald, Pa., and Steubenville, O., in which it was stipulated that if the duty requirements were not equalled in the tests, amounts proportionate to the deficiency would be deducted from the price. At McDonald the deduction was to be on the basis of the capitalized value of the additional coal (presumably for one year) needed to operate the plant at its contract duty. At Steubenville the amount of deduction for each 1,000,000 ft.-lbs. deficiency was to be determined at the signing of contracts.

In this issue are illustrated and described two current meters, and a third is referred to as published in this journal in March, 1893. Two of these meters have electric registers, and the third which is the simplest and cheapest of the three, is pneumatic in its action. They each have their special field of application, have each been devised by engineers actively employed in the government survey of rivers, lakes, etc., and each instrument has been fully tested in government service. The description of each has been written or approved by its designer; and as to their respective merits, our readers must judge for themselves and with regard to the work to which they are to be put. The use of current meters, as a substitute for the older, more tedious and uncertain methods of float experiment or gage-tubes, is of comparatively late growth and the advantages of such meters over floats and gages are fully recognized. The one feature which has stood in the way of the more frequent use of these meters is their excessive cost; and the pneumatic meter of Mr. Price now certainly does much to eliminate this objection, for all work to which it is applicable. Our readers are also indebted to Mr. Price for the method of rating both electric and pneumatic current meters given by him in his article. Literature upon this subject of rating is scarce and much that does exist smacks too much of the class-room and too little of that practical knowledge only bought by long experience and thorough familiarity with the vagaries of river currents. Messrs. Haskell and Ritchie, in their more elaborate electrical current meter, introduce a further refinement in giving not only the velocity, but also the direction of a subsurface current, where such exists.

The introduction of the electric car into cities and suburban districts and as means of communication between towns and villages is proceeding at a pace that its original promoters can hardly have anticipated. It not only makes traveling easier for the people along the electric lines, but the trolley car is gradually superseding many other motors and vehicles. In cities and in country districts it has greatly reduced the use of horses, both for street cars and for private carriages. In Minneapolis and other cities, officers of the road have private trolley cars, sumptuously fitted, in which they take their friends about town, and in Boston and Toronto "palace" trolley cars can be hired for theatre or dinner parties, excursions, etc. On over 62 electric street railways the U. S. mails are now carried, sometimes in especially-equipped postal cars; and freight and express service over electric lines is rapidly extending and is now being furnished on nearly 50 separate roads. In New Haven, special trolley cars are permitted to carry raw materials to manufactories and finished products to the railway; at Spokane, trolley freight cars handle grain in bulk, and about many mines and factories special trolley lines transport materials. In Baltimore electric locomotives, operated on the overhead system, will soon draw regular passenger and freight trains through the new Belt Line railway tunnel. In Pittsburg, a contractor has used a special trolley line for hauling clay and gravel to the dump; in many cities snow is swept from the tracks and streets are watered from curb to curb by trolley cars, and in Toronto these same cars haul away the city's garbage. Trolley funeral trains, specially fitted up, are now to be hired, and in St. Louis trolley ambulances convey patients to the city hospitals. In fact, new uses are being constantly found for the electric car, and the development of electric transit between distant points seems only to have had a beginning.

The importance of giving fully every condition under which engineering observations and experiments are made, is well pointed out in Mr. Wisner's paper, printed in this issue. Engineering is only an exact science when the engineer is sure of all the facts in the case, and is not called upon to take anything upon faith. Too many writers upon engineering topics, especially writers for the technical press, assume that all that is necessary for general use is the mere statements of results, or the publication of a theory deduced from certain individual experiments. They forget that, unless all the conditions are fully known, the careful engineer will not use their deductions; and that the unwary engineer may be led into a trap by applying a theory or result deduced from elements and relations entirely dissimilar from those with which he is working. True engineering is founded upon the intelligent use of facts and conditions indicating natural mechanical laws; and to give new results without the means of verifying them by the experience, knowledge and judgment of other members of the profession, is simply wasted effort. Mr. Wisner points out the danger of blindly accepting data on the credit of an authority only, without duly considering the limiting conditions of these data. The mistake is one made by almost every engineer, some time in his career, and the caution to look out for it should be heeded. For the problem in hand, whatever it is, so-called physical facts, unbacked by a full knowledge of all controlling elements and conditions, are as likely to mislead as to teach the true solution.

That bonds must not be issued to raise money for the payment of floating indebtedness is the gist of a decision recently announced by the Massachusetts Gas and Electric Light Commissioners. The Boston Electric Light Co. petitioned the Commissioners for their approval of an issue of bonds to the amount of $900,000, of which $360,000 was to be devoted to the construction of underground conduits, $300,000 for the refunding of maturing bonds and $240,000 for the payment of floating debt. The Commissioners approve the issue of bonds for the first two purposes, but disallow the latter, saying, in their opinion:

> After an investigation of the company's accounts and condition, the board is not satisfied that the present plant, estimated at its fair structural value, will equal the present capital stock and bonds. At an early stage in the hearing, the weight to be given to this consideration was indicated, and every opportunity was offered to the company to show that the growth of its property had kept pace with the increase of its capital. For reasons, presumably satisfactory to itself, it did not establish this fact. Floating debt, representing the cost of the new plant needed to take the place of that which had become worn out and useless, is essentially a part of the expense of carrying on the business, and should be provided for, if possible, out of its earnings. The profits of the company have been, and are likely to continue to be, ample to pay a fair dividend and to extinguish this debt.
>
> Under such conditions the board does not believe that the interests of the company require that the debt be funded by the issue of bonds, as requested. Capital stock has no claim upon the earnings precedent to those of creditors, and not to be governed by this fact in the application of earnings is to endanger the well-being of the stock itself. If, for the early removal of this indebtedness, it shall be deemed advisable to temporarily reduce the present dividends, such a course will be likely to add to the ultimate value of the stock.

This is good financial doctrine and good sense to boot. So far as we now recall, Massachusetts is the only State which exercises supervision over the issue of securities by its corporations, and prevents the watering of stocks and the issuance of mortgage bonds, when the property mortgaged is not sufficient to make the bonds a safe investment. If similar conservative supervision were exercised by the other states of the Union over corporations, there would be fewer companies in the hands of receivers, and investments in corporation securities would be less of a gamble than is at present the case.

Since the above was in type, our attention has been called to the fact that Texas, under a law recently enacted, requires issues of railway bonds or stock to be approved by the state railroad commission prior to their issue. A circular, just issued by the commission, gives rules of procedure in applying for consent for an issue of securities, and closes with the requirement that "the amount of stocks and bonds together, in the aggregate, must not exceed the reasonable value of the property of the company issuing them."

We briefly described in our issue of Dec. 25 the tunnel under the Seine, driven under the direction of J. Berlier, and stated that he was made a Chevalier of the Legion of Honor at its completion. The Boston "Transcript" comments on this as follows

> To American engineers the interesting part of the whole business is the fact that when the work was accepted by the authorities, M. Berlier was made a chevalier of the Legion of Honor, the assistant engineer was decorated by the Academy, and medals were distributed among the workmen. It would be interesting to know just how many public honors have ever been given to Mr. Carson, who has driven more difficult tunnels about Boston than this one at Paris, or what public acknowledgment there has ever been of the work of the St. Louis engineers in the new water-works tunnel at Chain of Rocks, or what mention, other than a brief newspaper note, has ever been made of Mr. Artingstall's tunnel for the Chicago Water-Works, or the exceptionally difficult water-works tunnelling of Mr. Benzenberg at Milwaukee. It is very likely that we become so accustomed in this country to the successful undertaking of works of exceptional engineering difficulty that they do not attract the notice they really deserve, and the men who carry them out are not given the credit which their work merits. The personal bravery of the men in charge of any of the works mentioned is a matter that cannot be understood by persons who have never been in a subaqueous tunnel, and it is unfortunate that it is very rarely that an engineer can be induced to tell of the difficulties under which he works. It is by no means unusual that the men will refuse to go to work unless the engineer or his principal assistant will go to the front with them, and so it happens that at the time politicians are complaining that the city officials are away from their offices, the truth of the matter is that they are working away in some dangerous place, of which the conception alone would drive their critics to the nearest saloon.

So far as we are aware, American engineers are not especially anxious for medals and decorations as a reward for their works. The profession

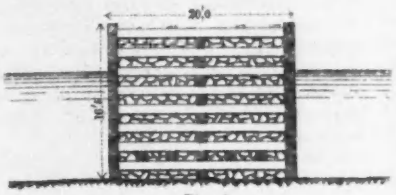


Fig. 1.

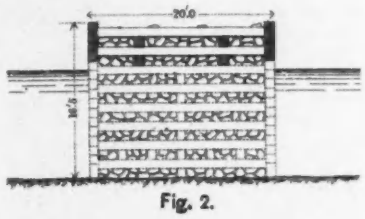


Fig. 2.

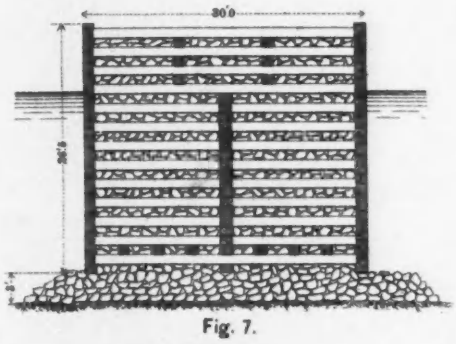


Fig. 7.

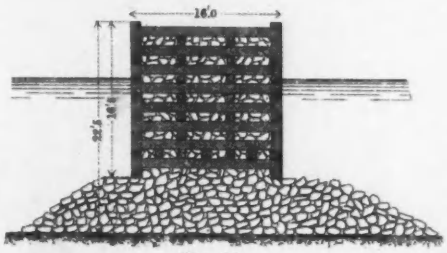


Fig. 11.

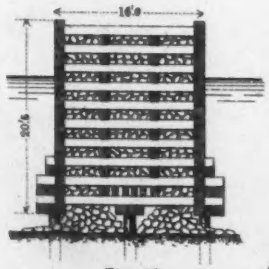


Fig. 10.

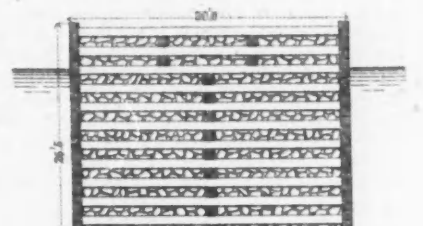


Fig. 3.

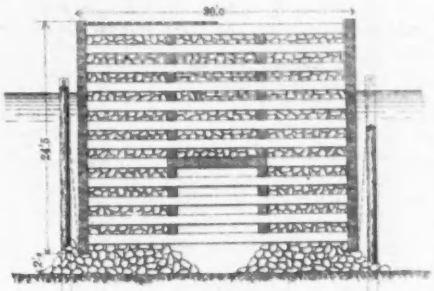


Fig. 4. (North Pier.)

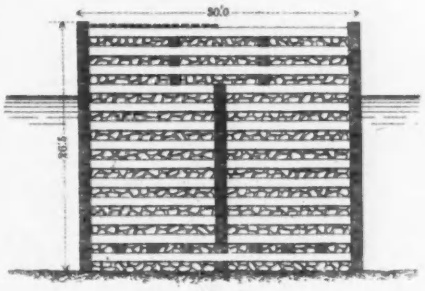


Fig. 5.

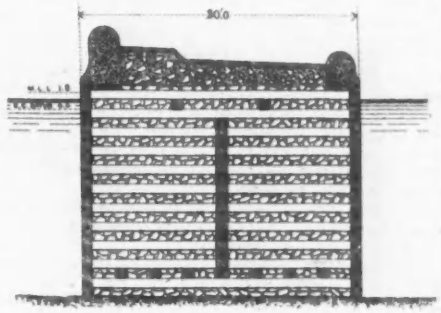


Fig. 6.

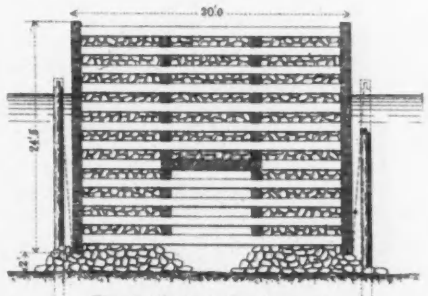


Fig. 8. (Easterly Breakwater.)

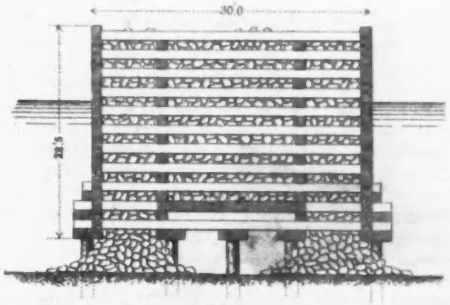


Fig. 9.

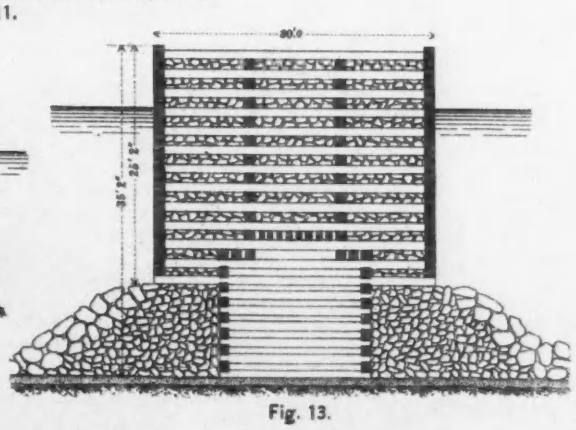


Fig. 13.

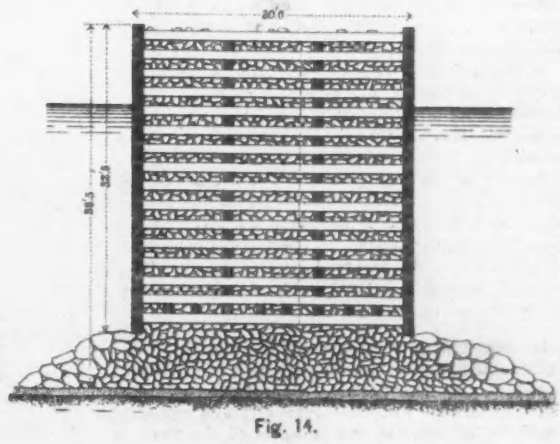


Fig. 14.

Fig. 12a.

Fig. 12b.

Crib Construction in Chicago Harbor.

W. L. Marshall,
Capt. Corps of Eng'rs., U. S. A.

CHAS. HART & SONS, LITH., 26 VESEY ST., N. Y.

would welcome, however, some of the public appreciation of which such bestowals give evidence, especially if it were accompanied by a willingness on the part of those who hold the purse-strings to pay higher salaries, so that a competent engineer might enjoy as large an income as an ordinary retail grocer without exciting public criticism.

The promoters who have been trying for two years past to start a mammoth scheme of power development at Duluth, Minn., have of late turned their attention to booming the proposed ship canal from Duluth to the Mississippi River, at Minneapolis. Mr. H. G. Spalding, the president of the Minnesota Canal Co. (whose water power development project was described in our issue of April 12, 1894), recently delivered an address on this proposed ship canal before the Commercial Club of Minneapolis. From the report of this address in the "Minneapolis Tribune," we learn that "the cost of transportation by water is one-fifth that by rail, and the expense of construction of a 20-ft. waterway (from Duluth to Minneapolis) would be one-fourth that of a railway." The "Tribune" also states, what is news to us, that Mr. Spalding "is a well-known engineer, both in Europe and the United States." It is fortunately true that neither the "Tribune's" assertion nor his own marvellous statements, above quoted, can make an engineer of the gentleman; but it is most unfortunately true that the public does not discriminate, and that these statements, ridiculous as they are, will be laid at the door of the engineering profession. It is little things like these that make many engineers, who take pride in their profession, long for some means by which the mountain of discredit that is constantly heaped upon it by just such occurrences may be prevented from greater accumulation.

We may say, with reference to the above statements, that the average rail freight rate per ton-mile in the United States, according to the last report of the Interstate Commerce Commission, was 0.878 ct., and the average cost of carrying a ton a mile on the railways of the United States was only 0.579 ct. Now, calling the length of the proposed canal 200 miles, by simple multiplication and division, we find that, if the canal is to carry goods at one-fifth the cost of rail transportation, it will have to carry a bushel of wheat all the way from Minneapolis to the lake at a cost of only 0.7 ct. As for the statement that a 20-ft. waterway across northern Minnesota can be made at one-fourth the cost of a railway, it is safe to say that the man who makes such a statement is not an engineer; what his proper title is will probably be found out later on by people who invest their money in the scheme.

Elsewhere in this issue is given a short table indicating the steady and marked drop in the price of iron and steel products in the United States during the years 1893 and 1894. This drop in some cases exceeds 33 per cent., and the whole record marks the two most disastrous years in the history of the iron and steel industry in this country. But while the lessons learned by our producers and manufacturers in this period is a bitter one, it is just possible that this so-called disaster may be the means of introducing better business methods and longer periods of national prosperity. While the prices quoted are in many cases those of forced sales at any price, it is doubtless true that the prevailing depression has also compelled all engaged in this and kindred industries to reduce the cost of production in every direction, to introduce new and improved machinery, to practice many economies, and finally to be satisfied with smaller profits than those which ruled in the old days of pools and a ready market at any price. Under these old conditions production was abnormally increasedl and at last far outreached the legitimate demand, and this is practically the condition to-day, and the prevailing low prices for products follow as a natural sequence. Under the old conditions, and while the demand was yet below the aggregate production, when buyers were plenty and struggling for material, high prices ruled and increased with the importunities of impatient consumers. The result of this method of conducting business was a constantly recurring succession of booms and depressions, keeping both consumer and producer in a constant state of unrest and seriously interfering with the substantial prosperity of both classes.

With the bitter lessons learned within the last two years by the industrial world, it is to be hoped that future operations will be conducted upon a somewhat wiser plan. It required a financial convulsion, like that we have passed through, to obliterate some of the more marked effects of a long period of inflation and of alleged prosperity founded upon false commercial doctrines and faulty business methods. One of the chief results of this depression is this lowering of the price of production, both to the producer and consumer, to a figure that forces a more careful, economic and intelligent administration than was necessary under old prevailing conditions. The aim should now be to keep these prices low, and those who have carefully studied the subject see little prospect for any marked advance over these here quoted, for the near future at least. Several conditions combine to this end. In the first place, since 1890, the iron and steel-producing capacity of the country has so increased, and new deposits of raw material and new centers of production have so multiplied, that we make more iron and steel than we can use, and the industry is too widely scattered to permit the forcing up of prices by pooling. Another condition is that low cost is rapidly widening the field for the use of iron and steel products, and as low price is a condition of such use it is only wise to encourage this new growth by keeping down the price. Manufacturers are again recognizing the fact that a steady and increasing market at figures that yield a reasonable return upon production is after all better than a spasmodic demand at much higher prices; an alternate running at boom pressure and a complete cessation of work, with no revenue and heavy fixed expenses. This steady work is better for man as well as master, for the same laws of income and outlay apply to both. The workman who studies the problem intelligently will soon recognize the fallacy of a condition of high wages and no work for long periods, when this condition is contrasted with reasonable but much lower wages and steady employment.

A very low price for brick street paving was recently bid at Lima, O. The amount bid was 83 cts. per sq. yd. for Zanesville-Hallwood blocks laid on 8 ins. of crushed stone and with Murphy grout filling between the blocks. This price, it is pretty safe to say, is below the actual cost of labor and material, and appears to have been secured through contractors filing unbalanced bids, notwithstanding the fact that separate bids were required for material and labor. The council let the contract for material to one firm and for labor to another. The only lower price for brick paving which we now recall was 61 cts. per sq. yd., at which 1,100 sq. yds. were let at Bellaire, O., last July. This contract, however, was for bricks on a gravel and sand foundation, and the bricks were hauled from the kiln direct to the streets, so that there was no expense for railway transportation. While these are doubtless "record" prices, they are, nevertheless, an interesting showing of the possibilities of cheap paving with brick, and deserve the careful attention of engineers. At prices not above $1 per sq. yd., brick can reasonably be claimed to be cheaper than macadam or telford, in view of its greater durability and smaller cost for cleaning and repairs. It appears to be certain that brick has a very large future as a paving material.

COUNTERBALANCING LOCOMOTIVES.

On another page of this issue we reprint lengthy extracts from three bulky papers which have recently appeared on the counterbalancing of locomotives. Within the past two or three years this subject has been taken up in a more thorough way than ever before, and the three papers which we have abstracted cover pretty well the results of the latest investigations.

For the benefit of our readers who have not the time or inclination to go into an extended study of this matter, but who desire to know what the "state of the art" is, we have determined to restate some of the important facts.

In the first place, it is true that the great bulk of the locomotives now in service are not so well balanced as they might be. There are nearly a score of different empirical rules in use for balancing, and the results obtained by them have varied all the way from very good to very bad. The harm which may be done by a badly-balanced locomotive to the track, and to its own machinery, and the serious strains which may be induced in bridges, make the matter of great importance, and make it imperative on every railway manager to see to it that any locomotives in the motive power of his road which are not known to be well balanced should be measured, calculated and corrected if need be, at the earliest possible time.

We now know that a badly-balanced locomotive may kink heavy rails so badly that they will have to be taken up and scrapped. We know that its wheels may actually be lifted off the rail at high speeds, and evidence that derailments have occurred from this cause has been presented. Such bad balancing occurs through the use of incorrect rules, or errors in applying them, through placing too much counterweight in the trailing wheels, on account of the difficulty of getting the proper amount in the main driver, through the loss of lead from lead-filled counterweights, and through running dead engines or engines with their rods down at ordinary speeds.

Turning now to the practical question how a locomotive should be counterbalanced, we know that, in the first place, all the revolving weight should be balanced. The formulas worked out by Mr. R. A. Parke, M. E., of the Westinghouse Air-Brake Co., and presented by him in a paper read before the New York Railroad Club a year ago, still stand as the only correct rules for balancing which have ever been worked out. Mr. Parke's formulas were published in our issue of March 1, 1894, but since that time he has discovered an error in the algebraic work, by which the formulas were deduced, which corrected leaves the formulas, or rules, in the form given below.

The process of finding the proper weight of counterbalance for locomotive driving wheels naturally divides itself into four parts.

1. The wheel itself, including the crank and crank pin, must be balanced by a certain weight of counterpoise.

2. The weight of the parallel rod or rods which the crank pin carries requires a certain additional weight in the counterpoise.

3. The counterpoise of the main driving wheel should have a certain additional weight to balance the vertical influence of the main rod and reciprocating parts upon the crank pin.

4. A certain additional weight should be equally distributed among the counterpoise of the several wheels to secure partial horizontal balancing of the main rod and reciprocating parts.

The calculation of the counterbalance weight necessary to balance the wheel itself is a simple matter of computing weights and leverages, similar to the balancing of any other body rotating about its axis, and need not be explained here. The additional weight in each wheel needed to balance the parallel rod is calculated in a similar way, the weight of the parallel rod which is carried by the wheel being supposed to be concentrated at the center of the crank pin.

For finding the additional weight which should be added to the main driver to balance the vertical influence of the main rod and reciprocating parts, Mr. Parke gives the following rule:

The weight of additional counterbalance in main driver required to balance the vertical influence of the connecting rod and reciprocating parts, multiplied by the distance of its center of gravity from the center of the wheel, equals the weight of the connecting rod multiplied by the quantity:

$$r\,\frac{\frac{1}{2}\,l^2 - \frac{1}{4}\,r^2}{l^2 - r^2};$$

plus the weight of the piston, piston rod and crosshead multiplied by the quantity;

$$r\,\frac{r^2}{l^2 - r^2}.$$

In these equations r = the distance from the center of the driving wheel to the center of the crank pin, and l = the length of the connecting rod between centers.

A locomotive with counterbalances applied according to the above rules will be in perfect vertical balance at all speeds. That is, there will be no increase of pressure on the rail when the counter-

balance weights are down, and no tendency of the wheel to lift from the rail when the counterbalances are up.

It is now necessary to add something to the counterbalance weights to balance the horizontal effect of the reciprocating parts. What percentage of their weight should be balanced is a matter which we discuss below; but whatever the percentage may be, the rule developed by Mr. Parke is as follows:

Let the weight of additional counterbalance required to balance the horizontal effect of a given percentage (= m) of the weight of the reciprocating parts = W_4. Then $W_4 \times$ distance from its center of gravity to the center of the axle $= \frac{m\ r}{l^2 - r^2}$ multiplied by the quantity: Weight of connecting rod $(\frac{1}{2} l^2 - \frac{3}{4} r^2) +$ weight of piston, piston rod and cross-head $(l^2 - 2 r^2)$. The quantities r and l have the same value as above.

It must be understood that all the weight thus added to balance the horizontal effect of the reciprocating parts acts vertically as an unbalanced weight; and, provided the revolving parts are correctly balanced according to the rules above stated, it is this additional counterbalance, and this alone, which produces the hammer blow on the rail. It is manifest, therefore, that although, so far as balancing the horizontal effect is concerned, it makes no difference how this additional counterweight is distributed among the drivers, to make the hammer blow at a given point on the rail as small as possible, this additional counterweight should be divided equally among all the drivers.

What percentage of the weight of reciprocating parts should be balanced will depend upon the class of engine, the speed at which it is to run, and other considerations. The Southern & Southwestern Ry. Club Committee, whose report we shall give next week, recommends that modern heavy, well-designed locomotives, with comparatively light reciprocating parts, should have 50% of the weight of these parts balanced; that lighter engines, less able to withstand strains and absorb the inertia of the reciprocating parts, should have 66% of the weight balanced; and that compound engines, with very heavy reciprocating parts, should have 75% of the weight balanced.

It will be seen that this committee represent the motive-power side of the case, and have gone on the principle that the engine must ride steadily anyway, and the track must take the rest as hammer blow. Probably a committee of track supervisors and bridge superintendents would tend to the opinion that the locomotive with the heaviest reciprocating parts should have at most no more counterbalance than the engines with lighter pistons and cross-heads. It must be conceded, however, that managing officers will invariably insist that trains must be hauled without jerking, whatever happens to the track.

Computations and practical experience show that common types of locomotives, running at ordinary speeds and balanced according to the above rules, will ride well and will not produce an excessive hammer blow upon the rail. But locomotives with excessively heavy reciprocating parts, or those which have exceptionally heavy wheel loads, or those which are run at very high speeds, ought, at least, to have their hammer blow calculated, to ascertain whether it is in excess of the safe limit.

Perhaps the most important and obvious moral that is taught by the recent investigations is that the weight of reciprocating parts ought to be reduced. If, in the above formula for balancing the reciprocating parts, we suppose the length of the connecting rod to be eight times the length of the crank radius, we find that the vertical effect of a counterbalance weight sufficient for full horizontal balance will be the same as if the weight of the piston, piston-rod and cross-head, and half the weight of the connecting rod were concentrated at the crank pin. We may also note that, at a speed of 60 miles an hour, which almost any locomotive in fast passenger service may attain over short distances with a 6-ft. driver and 24-in. stroke, every pound of weight in the reciprocating parts that is counterbalanced produces 26 lbs. of hammer blow upon the rail, and every pound of weight in the connecting rod produces 13 lbs. of hammer blow upon the rail.

Remembering that the hammer blow increases as the square of the speed, it is evident that locomotives designed for fast service should have their reciprocating parts made as light as possible, and that it will pay well to do it. Already a number of railways have begun the use of cast steel pistons and are modifying their designs with a view to saving weight. There is still large room for improvement, however, and we shall probably see pistons and cross-heads forged of nickel steel. With such a material in the hands of an intelligent designer, there is no reason why the weight of reciprocating parts should not be brought down to half, or even a third, of the weights now common.

We may appropriately refer in this connection to the popular belief, which appears to be especially prevalent among electrical engineers, that the "hammer blow" is a serious and irremediable drawback to the steam locomotive. While a badly-balanced locomotive may do serious damage, the investigations which have been carried out show that with counterbalances correctly applied, and the reciprocating parts reduced in weight, as they easily may be, a steam locomotive can run up to any speed thus far recorded without producing an excessive hammer blow or causing vibration of the train.

The current talk concerning hammer blow has also had the effect of encouraging a number of inventors to work out designs of "balanced" locomotives, by which is meant one so devised that reciprocating parts of the same weight are given equal motion in opposite directions at the same time. If they can design such a locomotive without increasing its cost over that of the present type of engine or making it more complicated or less satisfactory in any way, they may have some chances of success; but it should be plainly understood that a few dollars expense in a better material for reciprocating parts, with intelligent design of these parts and proportioning of the counterbalance weights will make the present locomotive practically unobjectionable in this respect.

LETTERS TO THE EDITOR.

RULE FOR CALCULATING HORSEPOWER FOR CAR PROPULSION.

Sir: Your correspondent J. B. asks for a rule for calculating the horse-power necessary for propelling cars.

On a level, $HP. = \frac{W \times K \times S}{375}$

On a grade, $HP. = \frac{W\ S}{375}$ $(K \pm 2{,}000 \sin \theta)$; or, approximately, on a grade, $HP. = W \frac{3.\ S + (2. \times \%)}{37.5}$.

In which W = weight in tons;
S = speed in miles per hour;
K = constant assumed at 30 lbs.;
θ = angle of elevation;
% = per cent. of grade.

Yours truly, Waterman Stone.

Providence, R. I., Jan. 6, 1895.

THE NEW YORK CIVIL SERVICE EXAMINATION FOR ENGINEERS

Sir: In the last number of your journal the papers for the written examination for engineering positions in the state service are given. It seems desirable to say in relation to these examinations that the answers to the questions given in your paper constitute only a part of the examination. The four examiners were kept busy for nine hours, at the last examination, in examining the candidates orally. The subjects of previous education and experience are also elements in obtaining the standing of the applicant. It is customary to give a relatively higher weight to previous education in the lower grades and a higher weight to experience in the case of the Assistant Engineers. In the case of Levelers, previous education and experience are given equal weights. The answers to the oral examination are taken down by stenographers, in case they should be needed for reference, but the markings are made by the examiners at the time. The use of instruments always forms a part of the examination. An examination, unless extending over several days and including actual work in the field, must always be rather unsatisfactory, but in the very limited time at the disposal of the examiners they always strive to obtain as good an idea of the candidates' fitness as is possible. I think it can be fairly claimed that the relative standing of the applicants closely represents their relative efficiency; the appointing officer must judge of the actual efficiency during the probationary term for which the appointment is always made in the first instance.

Typographical errors occur in question 16 of the Rodman's paper, where "grains" should be "grams"; and in the 12th question for the Levelers, where the distance 1.28 chains should be 21.28 chains.

Very truly yours, Horace Andrews,
Chairman of Board of Examiners.

Albany, N. Y., Jan. 1, 1895.

TIGHTNESS OF CEMENT JOINTS IN PIPE SEWERS.

Sir: The experiments on the tightness of pipe sewer joints, made by Mr. Freeman C. Coffin, and described in Engineering News of Jan. 3, are of exceptional interest to engineers having sewers to construct on the separate system, as we have as yet but little data on the subject.

It is thought that the amount of leakage to or from pipe joints is greater than is popularly supposed, and that even the majority of sewerage engineers underestimate the difficulty of procuring work that is practically tight.

I had occasion, some years ago, to lay a line of some 1,100 ft. of vitrified clay pipe, 6 and 8 ins. in diameter, to convey the overflow from a tank to a sewer. The soil was a dry, loose sand, and the pipe was laid in a shallow trench, as an inverted siphon, with a maximum head of about 4 ft. The pipe was in 2-ft. lengths, with standard sockets, and the cement, mixed 1 to 1, was Louisville (Black Diamond), a strong and quick-setting brand. As soon as a joint was laid, it was lightly covered, to protect it from the hot sun. After turning on the water, leaks would be at once apparent by a dampening of the soil near the joints, and these would then be uncovered, cleaned and refilled, or, if necessary, a section would be entirely relaid. The work was done with a good deal of care, but under these conditions it was found impossible to prevent considerable leakage.

For such work I would use a thin gasket of oakum, soaked in grout, in a deep socket joint, in spite of Mr. Coffin's adverse results with gaskets, as in practice I believe it will prevent, to a considerable extent, the disintegration of the green mortar by water.

The comparatively good results obtained by Mr. Coffin with 1 to 1 Rosendale as compared with either Portland or neat Rosendale is unlooked for, and, I think, might vary materially with different brands of cement.

Deep sockets and long joints should be required on all sewer work, in preference to the "standard" form, and where tight work is required, Mr. Coffin's plan of making half the joints above ground in cradles would be well worth trying. Yours truly, Kenneth Allen.

Yonkers, N. Y., Jan. 4, 1895.

THE BEST CEMENT FOR MAKING CONCRETE.

Sir: Referring to your article on the report of the State Engineer of New York excluding Rosendale cement from use on the canal improvements, and Mr. C. M. Harris's letter, published in your issue of Nov. 29, on the relative value of Portland cement and natural cement, the writer is able, through the kindness of Messrs. Hazlehurst & Huckel, architects of the Odd Fellows' Temple, Philadelphia, to give the result of some tests made with Portland cement in comparison with Rosendale cement, the tests being made with the idea of finding out which was the cheapest to use in the building. The cements used in these tests were a Rosendale from one of the largest and most reliable manufacturers in Utica county, N. Y., and an American Portland cement manufactured at Copley, Pa.

Tensile Strength of Cement Briquettes of Various Compositions and Ages (Figures give average strength in lbs. per sq. in. of five briquettes of 1 sq. in. cross-section.)

	—Portland Cement.—		—Rosendale Cement.—	
Age, days.	1 to 3 river sand.	1 to 4 river sand.	1 to 1 bar sand.	1 to 2 bar sand.
7	160	105	90	45
14	200	135	109	56
21	230	146	131	78
28	231	165	145	101

The Portland cement was selected for the work, the tests proving it to be the cheapest to use.

Now, in reference to Mr. Harris's claim that 1½ bbls. of the best Rosendale will produce as much concrete and of as good quality as 1 bbl. of Portland cement, backed by the writing of Gen. Gillmore, I would say (without in any way meaning to detract from such an eminent authority as the General), that this is not a fact, at least not if the good grades of Portland are used. By the term "good grades" the writer means those of the standard of the best American and German mills, and not of the Belgian standard, as the bulk of the cement shipped to this country from Belgium, although marked Portland, is no more entitled to such classification than the Rosendale cements.

It must be remembered that it was in 1883 when Gen. Gillmore wrote that he found 1½ bbls. of Rosendale cement to be equal to 1 bbl. of Portland cement for concrete work, and that the bulk of the Portland cements on the market at this time were English brands, which only had a tensile strength of 250 to 300 lbs. per sq. in. at the end of seven days, and

ground so that 80% to 85% would pass through a sieve having 2,500 meshes per sq. in. To-day Portland cements are manufactured in this country and Germany that stand a tensile strength of from 400 to 500 lbs. per sq. in. at the end of seven days, and ground so that 90% to 95% will pass through a sieve with 10,000 meshes per sq. in., and these Portlands sell for very much less than the poorer quality did at the time of Gen. Gillmore's writing. The price of Rosendale has not dropped in proportion to the Portland, and we doubt, from what we hear from the engineering profession about the lack of uniformity in the cement produced at the leading Rosendale factories, whether the quality of these natural cements, as a class, has improved any during the past ten years. This being the case, it is not well to place too much dependence upon an opinion of Gen. Gillmore's, which was based upon a different state of the cement market than exists now.

Philadelphia, Jan. 4, 1895. Wm. G. Hartranft.

A NEW CURRENT METER AND A NEW METHOD OF RATING CURRENT METERS.

By W. G. Price, U. S. Asst. Engineer.

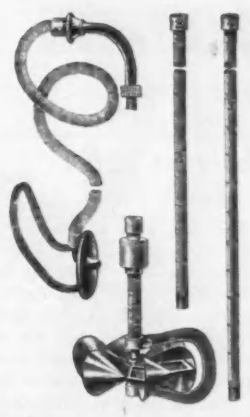
This meter was constructed for use in measuring velocities of water in shallow rivers and canals, where it can be supported at the proper depth by being attached to the end of a metal rod or pipe, which is held in the hand of the observer. It was designed to meet the following conditions, viz.: The wheel must be strong enough to withstand quite hard knocks, which it is liable to receive while in use, without being injured. The bearings of the wheel must be so constructed that the friction will be very slight and a constant quantity. Means must be provided for counting the revolutions of the wheel, and the mechanism used must not appreciably add to the friction of the bearings.

The meter, as constructed, has a strong wheel composed of six conical-shaped cups, bound together by a solid frame, which revolves in a horizontal plane, and is carried on two bearings, which are at the top of deep inverted cups, which hold air and oil, which at all times entirely excludes the water and the grit or other matter which the water may contain. Just above the upper bearing there is a small air chamber, and the shaft of the wheel extends up into it. The water cannot rise up to the air chamber, as it cannot compress the air sufficiently to do so. In the air chamber there is a small worm gear on the shaft, which turns a small wheel which has 20 teeth. The wheel carries a pin, which for every 20 revolutions of the shaft depresses and releases a pin-head spring hammer which strikes a small diaphragm that forms the top of the air chamber. The rod which is used to support the meter is hollow, and the diaphragm is at the bottom of the rod. The sound produced by the striking hammer is transmitted through the rod and through a connecting rubber tube to the ear of the observer. The ear-piece is held in place with a band of elastic ribbon. The rod is in lengths of 2 ft., and is graduated to feet and tenths. The wheel is 5 ins. in diameter and the meter, without the rod, weighs 17 oz. A meter constructed in this way will not change its rate so long as it is well cared for and is not bent out of its original shape. A few drops of thin oil, such as will not become solid in cold water, must be placed in both bearings once every day it is used. Even though the water to be measured carries in suspension a large quantity of silt and other matter, it cannot injure the meter or change its rate.

The method of rating this meter, which is also applicable to the electric meter, is as follows: The rating should be made in a pond of still water, and a test with rod floats should be made to determine whether the water is absolutely still or not. A small, deep pond is best. In many of the large crescent-shaped lakes, along the Mississippi and Missouri rivers, which have no inlet or outlet, there is a small oscillation of the water, probably caused by the wind, which will render a rating made in them quite inaccurate. The meter should be attached to the bow of a skiff, so that the supporting rod will be vertical, and the wheel will be about 2½ ft. below the surface of the water.

Take two metallic tapes, each 50 ft. long, and lengthen one of them with 100 ft. of steel wire, about No. 24. Take the tapes out of their boxes and wind them on two wooden reels which are about 6 ins. in diameter and are placed side by side on a single shaft on which they are free to turn independently. The reels must be provided with pawls with sharp points which can be pushed into the wood to stop them from turning. The shaft and pawls can be supported by a wood frame, and this should be screwed or nailed to the forward seat in the skiff. The oarsman sits in the after seat. The observer sits just forward of the reels, and the rubber tube leads from the meter rod to his ear. The tapes are unreeled far enough to pass the ends over the stern of the skiff and to a stake which is driven firmly at the water's edge, and which has a nail driven half its length into the top. Rings of about No. 20 cotton thread are tied in the ends of the tapes, and are passed over the nail in the stake. The oarsman then rows the skiff straight away from the stake, and the tapes are unreeled as the skiff moves along. A little friction from the hand of the observer on the reels keeps the tapes taut.

When the observer hears the first click, made by the hammer in the meter, he instantly starts his stop-watch and presses a pawl into the wood of the reel which carries the 50-ft. tape. This stops the motion of the reel and breaks the thread which connects the tape to the nail in the stake. When the meter wheel has made 40 revolutions the observer will hear the third click, and at that instant he stops his watch and presses the second pawl into the second reel, which stops the long tape from paying out and breaks the thread which attaches it to the nail in the stake. The difference in the reading of the tapes at the reel, plus 100 ft., will be the distance the meter travelled while the



Price Pneumatic Current Meter.

wheel was making 40 revolutions, and the reading of the watch is the required time. The reading of the tapes must be corrected for any error there may be in their length.

Data should be obtained for very slow, medium and high velocities, and to obtain the high velocities, it will be necessary to pull the skiff with a ¼-in. cotton rope, which can extend from the bow of the skiff to the opposite bank of the pond; but if this is done the oarsman should be retained in the skiff to stop it from running into the bank and to return it to the starting position. If the pond is very wide, a long stake may be driven out in the pond, and it can be made rigid at its top with small guy ropes, which can lead diagonally down to the bottom of other stakes, which are driven around it, the ropes being tied to the stakes before they are driven and then all attached to the center stake. The skiff can then start from this stake, and the pulling rope can lead to the shore. If the skiff is propelled at all velocities with a rope in this way, the rating will be more accurate, as the motion of the oarsman in rowing rocks the skiff and thus causes the meter to travel through a curved path which is longer than the distance measured with the tapes. Just before each trip is made over the base, the meter wheel should be turned till it is about midway between two clicks, so that the first click will be heard by the observer before all of the short tape is paid out. The wheel will make 40 revolutions in about 103 ft. A longer wire can be used to lengthen the tape, so that a measurement for 60 or more revolutions may be made.

The amount of error in such a rating, supposing the skiff to move at the same velocity at the instant the first and last clicks are made, depends entirely on the time intervals used by the observer in starting and stopping his watch, and in stopping the reels after he hears the click of the meter. In order to eliminate all error, the time consumed by him to do this must be the same at the beginning as at the end of the trip.

When the data are reduced to revolutions of the meter wheel per second and velocity in feet per second and then plotted on cross-section paper, taking the revolutions per second as abscissas and the velocities in feet per second as ordinates, the plotted points will lie in a curve. A line can best be drawn through these points by bending a true steel straight-edge between three heavy paper-weights till one side of it coincides with the points. It has been the usual practice to assume that this line should be straight and expressed by the equation $y = a \times b$, from which it is easy to compute a reduction table; but when more accurate ratings are made, so that all the plotted points are in their true positions, it is found that the elastic curve formed by the bent straight-edge passes precisely through them all. This curve departs so much from a straight line, it is seen, that to compute the reduction table upon the assumption that the line should be straight is a very inaccurate method. By an inspection of the curve, it will be seen that for successive higher velocities the revolutions per second increase faster than the velocities in feet per second. This indicates that the slip of the wheel or the screw, as in a steamship propeller, becomes less as the velocity increases; and we can think of a velocity so great that the water would become in effect so near a solid there would be no slip, and beyond that point the rating would be a straight line.

The friction of the bearings of a meter should be so slight that the wheel will begin to revolve when a very low velocity is attained. For the first pneumatic meter constructed this velocity was .042 ft. per second. In order to make a reduction table from a meter rating, form a three-column table and write in the first column the times in seconds of 100 revolutions of the meter wheel, from 20 seconds to 400 seconds, or more if very slow velocities are to be measured. Then compute the revolutions per second corresponding to those times of 100 revolutions, and write them in the third column. Then, from the plotted curve, scale off the velocity in feet per second corresponding to those revolutions per second, and write them in the second column. In using the meter, measure the time of 100 revolutions and look in the table for the corresponding velocity. Such tables are usually furnished by the manufacturers.

In our issue of March 2, 1893, we described a current meter with an electric registering attachment, also invented by the author of the above article. The pneumatic meter above described is a much simpler and cheaper device, and is recommended as preferable for use in shallow rivers and canals. We are informed that this meter is to be made and put on the market by Messrs. W. & L. E. Gurley, of Troy, N. Y., and that the price is only $50.

THE RITCHIE-HASKELL DIRECTION-CURRENT METER.

In conducting the hydrographic surveys for harbor and river improvements, it is often desirable to know the direction as well as the velocity of the prevailing currents, in order to calculate their value for good or harm. In tidal streams, for example, for some time before the turning of the tide, an "under run" of the flood tide is going on while the surface is still ebbing. These sub-currents of tidal waterways are of extreme importance in their effects upon the sea bottom and need to be determined with considerable accuracy both in direction and velocity. For determining the velocity of currents, one of the common methods, viz., by floats, gage tubes, or current meters may be used, but the last two methods give nothing concerning the direction of the current. The instrument which we illustrate herewith has been designed to record, simultaneously, both the direction and velocity of any character of subsurface currents. This instrument is the invention of Mr. E

E. Haskell and Mr. E. S. Ritchie, and is known as the Ritchie-Haskell direction-current meter.

A view of the Ritchie-Haskell meter, ready for operation, is shown in Fig. 1. The principal differences of appearance between this and the ordinary form of current meter are the propeller wheel and the fish-shaped body, inside of which is placed the magnetic needle and other mechanism for actuating the recording apparatus in the hands of the operator.

The velocity wheel is of the screw or propeller

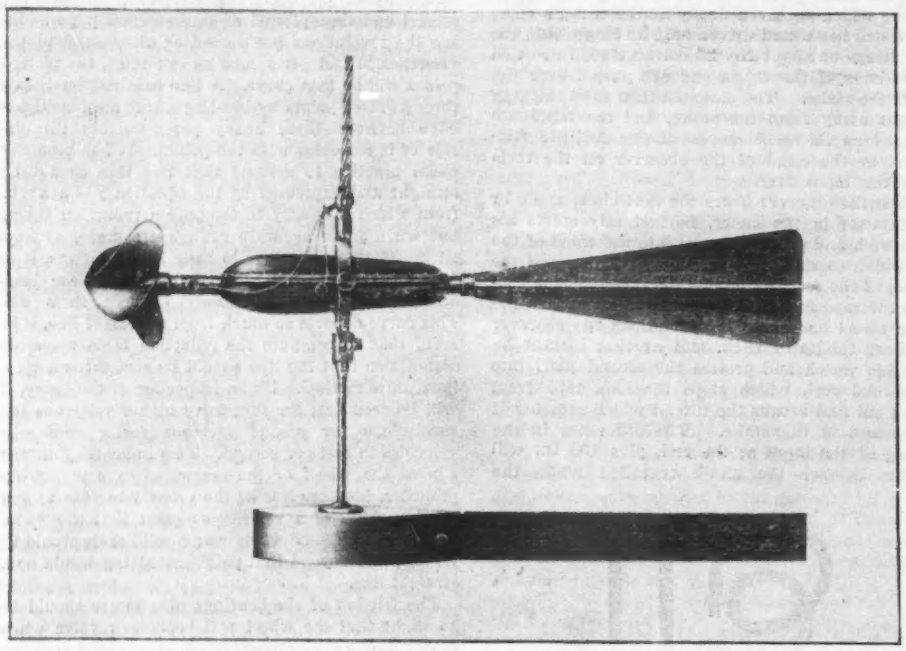


FIG. 1. THE RITCHIE-HASKELL DIRECTION CURRENT METER.

type, and is made conical in form, to prevent the catching of weeds, grass and other floating debris. This wheel may have any desired pitch to suit any kind of work, but thus far only two styles of wheels have been made, the first covering a range of from 0.2 ft. to 6 ft. per second in velocity, and the second a range of from 0.6 ft. to 12 ft. per second in velocity. Of course, a meter can have both of these wheels furnished with it, so that either one can be attached as desired. The electric mechanism for transmitting the number of revolutions of the wheel to the velocity register is, as stated above, placed inside the fish-like body of the meter. In the velocity register (Fig. 2) starting the watch closes the circuit, and stopping the watch breaks the circuit, thus giving an absolute record of the time and the corresponding number of revolutions made in that time.

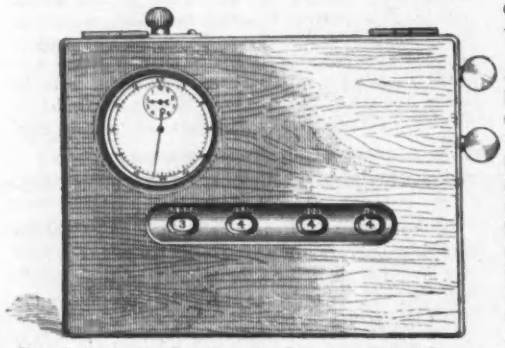


Fig. 2. Velocity Register for Ritchie-Haskell Direction Current Meter.

The apparatus for determining the direction of the current and actuating the direction register is also placed in the fish-like body of the instrument. This apparatus consists primarily of a compass, whose needle is free to assume the magnetic meridian at all times, immersed in an oil chamber to prevent rust. An expansion bag compensates for changes in temperature and establishes equality of pressure between the inside and outside of the chamber when submerged. By the use of an electric current the angle, to the nearest degree, between the direction of the current and the compass needle is shown on the dial, Fig. 3. This dial is graduated in azimuth from south to west, and also has the points of the compass given.

The total length of the meter illustrated, which has a low-pitch wheel 7½ ins. in diameter, is 36 ins. and its weight is 30 lbs., exclusive of course of the lead weight, which can be adjusted to weigh 20 lbs., 35 lbs., or 50 lbs., as desired. The cable for suspending the meter is of galvanized Bessemer steel, 7-16 in. in diameter, with a core formed by the three insulated wires—three circuits being required for both recording registers—from the meter to the recording apparatus. The total cost of the apparatus, including both velocity and direction registers, is $280. Extra wheels cost $25 each. The meter, without the direction-recording apparatus, can also be secured in various sizes and styles. One of these meters, which is especially designed for gaging brooks, creeks and irrigation ditches, is shown in Fig. 4. In this instrument the suspending cable is replaced by a graduated hand rod and a foot-plate is provided to prevent the wheel from sinking into the mud of the bottom. This instrument costs $130, is 14 ins. long, with a 4-in. diameter wheel, and weighs 7 lbs. It will register velocities varying from 0.4 ft. to 5 ft., and from 1 ft. to 10 ft. per second with the low and high-pitch wheels respectively.

These meters are now used by many of the United States Engineers in their hydrographic work, and have also been adopted by a number of large irrigation companies. In the Government work, Mr. Haskell has used the direction-current meter in measuring the currents in New York Harbor, Long Island Sound, the Gulf Stream and the Gulf of Mexico, since 1887, and states that he believes it to be reliable under all conditions. These motors are manufactured by E. S. Ritchie & Sons, Brookline, Mass. We are indebted to Mr. E. E. Haskell, Assistant U. S. Engineer, Sault Ste. Marie, Mich., for the matter from which this article has been prepared.

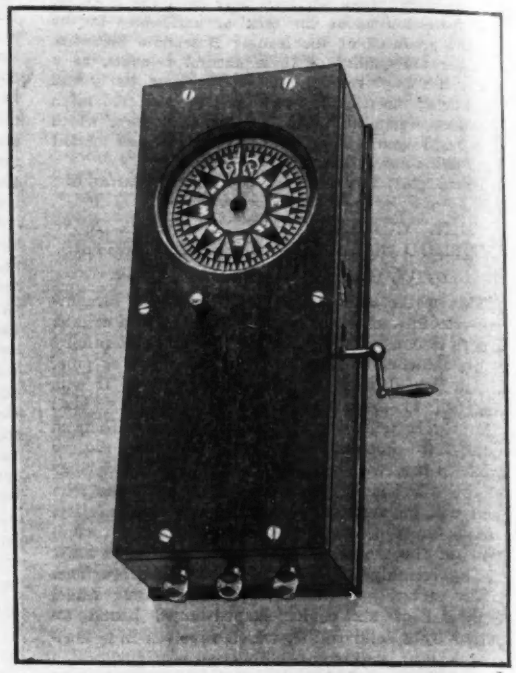


FIG. 3. DIRECTION REGISTER FOR RITCHIE-HASKELL DIRECTION CURRENT METER.

ENGINEERING FACTS VS. CREDULITY.*

By Geo. Y. Wisner, M. Am. Soc. C. E.

Engineering is generally considered an exact science, and if we fully understood all the conditions under which the observations and experiments were made, the results of which we are often obliged to accept on faith, it would be strictly true. It is an unfortunate fact, however, that our reference books have many examples of the determination of so-called physical facts, which, although correct for the circumstances under which the observations were made, are absolutely worthless for a basis in designing engineering works, for the reason that the relative conditions are unknown. It is, therefore, very evident that in accepting results from any authority as a basis for engineering design, we should know whether the conditions under which such results were obtained, were identical with those where it is proposed to make use of them, and if not identical, what will be the probable effect due to change of circumstances.

Two engineers may test the tensile strength of concrete made from the same barrel of cement, and obtain results differing over 50%, either of which might be very misleading if the methods of conducting the experiments are unknown, as is often the case. Tests of cement, made without any regard to the conditions under which it is to be finally used, may make a very creditable showing as to strength, and yet prove to be a complete failure in the structure.

One of the most fruitful sources of engineering failure has been due to accepting without regard to modifying conditions the results of experiments made to determine the relation between the rate of flow of a river current and the size of the particles which different velocities of current will move. Years ago the French engineer, Dubuat, found that water flowing at the rate of 3 ins. per second would move potter's clay; at the rate of 7½ ins. would move coarse sand; at the rate of 1 ft. would move small gravel, and at the rate of 2 ft. per second would be capable of moving round pebbles an inch in diameter. It would be difficult to find a reference book on river hydraulics published since Dubuat's observations were made that does not quote his results as authentic. Colonel Elliott in his report on the improvement of Nantucket Harbor assumes that a velocity of 1.25 ft. per second is sufficient to produce a scour on a bottom of sand and gravel, and quotes the following authorities: Debouve, 0.5 to 1 ft. per second; Login, 0.67 to 1 ft. per second, and Weisbach, 1.25 ft. per second.

Trautwine says that "Scouring action is supposed to be as the square of the velocity of current," and gives

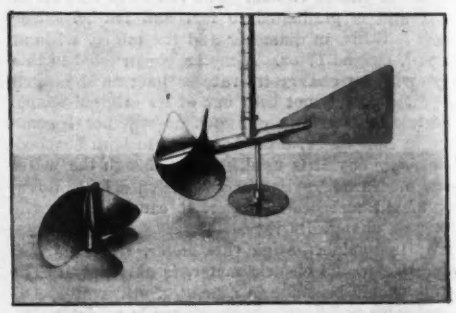


Fig. 4 Haskell Hand Current Meter for Irrigation Work.

* From "The Technic" of the Engineering Society of the University of Michigan.

examples nearly the same as the above. These authorities are all of such high character that the unsuspecting engineer might accept their results without question, and yet all are absolutely incorrect, except for the particular streams where the experiments were made. A board of distinguished army engineers, basing their opinion on results similar to the above, recently designed plans for the improvement of an important coast harbor on which several million dollars were to be expended, and in their report say that since the mean velocity of current across the bar will be 2.7 ft. per second, and the maximum velocity 5.4 ft. per second, such velocities through jetties on fine sand would endanger their stability. The absurdity of such fear is manifest when we consider that such velocities will not disturb the bottom, in mid-channel, in depths of over 18 ft. unless aided by wave action.

The amount of work that any stream is capable of doing is equal to its volume of discharge into its fall in a unit of time, and since the velocity of river currents varies rapidly with the depth, it is evident that the slope of large deep rivers must be very small, compared with shallow streams having the same velocity, and consequently the scouring action of any river, for any given rate of current, must be an inverse function of the depth. This being the case, to assume that any given velocity will produce certain results is equivalent to trying to solve a problem having two unknown quantities with a single equation of condition.

The action of river currents of different velocities and depths on the channel bed is very cleverly illustrated by the annual changes which occur in the bed of the Mississippi River, where the crests of the bars are raised during the high water and rapid currents of floods, and cut away during the low water stages when the depths are small and the slopes are steep on the shallow channels connecting the deeper pools. The fact that some engineer has found that a given velocity of current on some stream of unknown depth will move sand or gravel, has no bearing whatever on what may be expected of currents of the same velocity in streams of greater depths. In channels 3 to 5 ft. deep, a mean velocity of 3 to 5 ft. per second may produce rapid scouring, while in depths of 18 ft. and upwards, current velocities of 6 to 8 ft. per second often have no effect whatever on the channel bed.

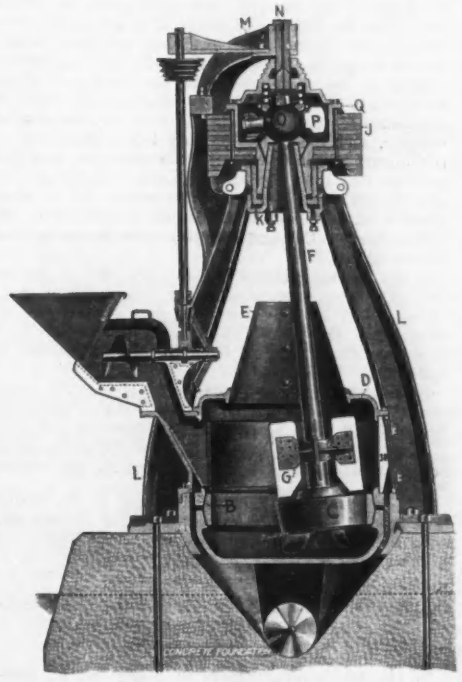
The amount of sediment that a stream, flowing with a given velocity, can carry in suspension has been a subject of bitter controversy among hydraulic engineers, and is by no means a matter on which they are mutually agreed at the present time. Humphrey and Abbot, in their extensive investigation, from 1850 to 1861, to determine the physics and hydraulics of the Mississippi River, conclude that no definite relation exists between velocity of flow and the amount of sediment held in suspension. Their failure to establish such a relation was largely due to the fact that their entire investigation was devoted to trying to determine the relative amount of sediment per cubic foot of water, at different velocities of current, without regard to depth of water, while the fact of the matter is, that the amount of material, and the size and weight of the particle which a stream can hold up and carry forward is a direct function of the current velocity, and an inverse function of the depth.

Motion cannot occur in matter without an expenditure of force. The transportation of sedimentary matter by rivers can, therefore, only result from an expenditure of force, which must necessarily increase with the height through which the material is lifted, or with the increase in depth of stream.

Many reference books on hydraulics give tables for computing the mean and bottom velocities of streams when the surface velocities are known. Under ordinary conditions these tables may give approximately correct results, yet there are many cases where such methods are certain to give erroneous results. For instance, at the mouth of the Mississippi River, the depths on the bars at the mouth of the passes are from 8 to 12 ft., while at a distance of 18 miles up stream the river is over 100 ft. deep, giving an average minus bottom slope up stream of 5 ft. per mile. Salt water being 3% heavier than river waters, flows down this slope (up stream) during low stages of the river at the same time that the surface water is flowing seaward, at the rate of 1 to 1½ miles per hour. During seasons of extremely low water the river water sometimes becomes brackish from this cause for over 100 miles from its mouth.

Another hydraulic problem over which engineers have always agreed to disagree is whether the confining of a sedimentary river within its banks by means of levees has a tendency to raise the river bed. A recent writer on this subject says: "Theoretically, and even without any reference to experience, it should be seen that building dikes along the shores of frequently swollen rivers must result in raising the bed over which the water flows." Is this true? In fact, does not the equalization of the river forces and the resistances overcome make such a result an impossibility? If by any means the slope of a river could be increased for any given stage of water, there can be no question but that the flow would be increased and consequently the capacity to produce scour correspondingly so. All rivers flowing into the sea have the level of the water surface at their mouths fixed by the sea level, consequently any raising of the river bed in the upper portions of the river must proportionately increase the slope between that point and the mouth. But, as we have seen above, increased slope means an increase of the force acting to erode the bottom, and therefore, to assume that levees have a tendency to raise the beds of rivers, forces us to the anomalous conclusion that an increasing scouring force produces a decreasing effect.

There is no doubt but that the beds of sediment-bearing streams do rise, whether the banks have levees or not, but there is no evidence that the building of dikes has in any case ever increased such action. If we take the Mississippi River, for example, it will be noticed that the slope at Cairo is about 6 ins. per mile, and gradually diminishes to 1 in. at the mouth of the river. The slope in the Passes is about double that of the main river directly above, showing that any change of depth and volume of discharge requires a corresponding change of slope. The average advance of the Mississippi River delta into the Gulf, previous to the improvement of the South Pass, was about four miles per century, and as the average



Griffin Grinding Mill.

slope from Cairo to the Gulf is about 4 ins. per mile. It is evident that a silting up of the river bed of over one foot must have occurred during such period in order to maintain the natural slope. In other words, the increasing length of the river, due to the advance of the delta into the Gulf, is the only apparent permanent cause for any rising of the river bed. This is equally true of the Po and the Yellow River, so often mentioned as examples of the disastrous effects of the rising of river beds—the only difference being that these rivers, having greater slopes than the Mississippi River, have a greater rise of bed in proportion to delta advance.

One great source of error in the results of observations and experiments often arises from an undue belief on the part of the engineer in the infallibility of his work and conclusions. It is fa' to presume that every engineer, in undertaking to determine the law governing some phenomena of nature, does his best to arrive at a correct conclusion, but if he fails to take cognizance of all the varying conditions that may exist, his results will probably be very misleading, when considered under other circumstances than those existing at the time his observations were made. Reports and treatises on engineering works contain many examples of this character, which the young engineer will do well to scrutinize closely before accepting them as a basis for designs for work where the conditions are not known to be identical with those on which previous conclusions and reports have been based.

THE GRIFFIN GRINDING MILL.

In the article on the Portland cement works of the Whitaker Cement Co., on another page of this issue, reference is made to the use of the Griffin mill for grinding or pulverizing both the raw material and the burned cement. We give herewith an illustration of this machine. The principle employed is that of a suspended crushing roll running against the inner face of a cylindrical die or ring. In the accompanying cut, A is the base, or pan, containing the fixed ring or die, B, against which works the crushing roll, C, and upon the inner vertical face of which the pulverizing is done. For dry pulverizing, the base, A, has a number of openings outside the ring, B, which lead into a receptacle below, from which the material is carried by a spiral conveyor. To the base is secured the screen frame, D, surrounded by a sheet iron cover (which is not used in the wet mill), and having a conical shield, E, secured to its top. The crushing roll, C, is c ed by the vertical shaft, F, which for dry grinding is fitted with the fan, G. On the underside of the roll are shoes or plows, H, the shape of which varies according to the material to be ground.

The driving pulley, J, revolves upon a taper adjustable bearing, K, which is supported by the standards, L, two of which are extended above the pulley, to carry the upper arms, M, in which is secured the hollow journal pin, N. Within the pulley, J, is the universal joint, from which the shaft, F, is suspended. This joint is composed of a ball, O, to which are attached trunnions working in the half boxes, P, which slide up and down in the pulleyhead casting, Q. The joint in the pulley is enclosed by a cover, which thus protects the working parts from dust and grit. Lubricating oil is supplied through the hollow pin, N. The universal joint, which connects the shaft to the pulley, allows perfect freedom to the roll, so that it can easily pass over pieces of uncrushable material, which may find their way into the mill.

The crushing roll is revolved within the die in the same direction that the shaft is driven, but it moves around the die in the opposite direction, thus giving two direct actions on the material to be ground. There is a pressure of 6,000 lbs., due to the centrifugal force of the roll, which is brought to bear upon the material to be ground, and the combination of the two actions is very effective. When the pan is filled with the material to be ground, the shoes on the crushing head stir it up and throw it against the face of the ring, the whole body of loose material whirling around rapidly in the pan. In wet pulverizing, the water is introduced with the feed, and the pulp is given a whirling or rotary motion, which carries it up against the screens. The principal dimensions of a 30-in. mill are as follows:

Extreme height above foundation	8 ft. 2½ ins.
Extreme width	5 " 3 "
Weight	8,000 lbs.
Diameter of pulley	30 ins.
Diameter of ring or die	30 "
Diameter of crushing roll	18 to 20 "
Depth of contact surface of roll	6 "
Weight of ring	200 lbs.
Weight of tire	100 "
Pressure of roll against die	6,000 "
Speed of pulley, revolutions per min.	190 to 200
Power required	15 to 25 HP.

The capacity is from 1½ to 2½ tons per hour on Portland cement, quartz or other rock (according to hardness of material and fineness of product), and 3 to 4 tons per hour on phosphate rock. The mill pulverizes from 30 to 250 mesh. This mill is manufactured by the Bradley Pulverizer Co., of Boston, Mass.

COMPARATIVE FUEL CONSUMPTION ON ELECTRIC AND STEAM RAILWAYS.

In our issue of Oct. 18 was presented the official report of Mr. William Barclay Parsons, Chief Engineer to the Rapid Transit Railroad Commission of New York, upon rapid transit in foreign cities. This report has now been issued in book form with some additions and further comment. In discussing the proposed electrical traction on the underground line and in comparing this with steam as ordinarily applied on railways, Mr. Parsons sets forth in detail the advantages of the electrical power. Aside from the absence of smoke, better ventilation as a consequence and the greater ease in adjusting power to varying demands, electric traction has other advantages. The chief of these

Relative Cost of Pier Work, 100 lin. ft. in length, 20½ ft. high, According to Different Plans Used in Chicago Harbor.

	Height, ft.	Width, ft.	Figures.	Amount built, lin. ft.	When built.	Where.	Materials required. Timber, ft. B. M.	Dr. bolts, lbs.	Stone, cords.	Piles, No.	Cost. Timber.	Dr. bolts.	Stone.	Piles.	Totals.	Per lin. ft.	Add'l each 2 add'l courses.	Percentages of cost Timber.	Dr. bolts.	Stone.	Piles.
Cribs and superstructure.	20½ ft. [a]	30	3	400	1864-69	North Pier															
		30	5	2,250	1870-72	Easterly Br. Water	152,736	18,490	338.0	.....	$4,276.61	$739.60	$2,029.20	.....	$7,045.41	$70.45	$681.36	60.7%	10.5%	28.8%	....
		30	4	600	1875-76	North Pier															
		30	8	150	1875	Easterly Br. Water	113,520	10,712	307.1	24	3,178.56	428.48	1,842.60	$288.00	5,737.64	57.38	643.83	55.4 "	7.5 "	32.1 "	5.0 "
		30	7	1,900	1873-75	Easterly Br. Water	124,176	14,735	407.0	.....	3,476.93	589.40	2,442.00	.....	6,508.33	65.08	681.36	53.4 "	9.1 "	37.5 "	....
		30	9	300	1879-80	Southerly Br. Water	155,100	11,220	340.0	53	4,342.80	448.80	2,040.00	636.00	7,467.60	74.68	593.35	58.2 "	6.0 "	27.3 "	8.5 "
		30	13	4,251	1881-87	Exterior Br. Water	115,738	9,724	279.7	.....	3,240.66	388.96	1,678.20	.....	5,307.82	53.08	542.40	61.1 "	7.3 "	31.6 "	....
		30	14	1,162	1888-89	Exterior Br. Water	87,388	7,235	523.5	.....	2,446.86	289.40	3,141.00	.....	5,877.26	58.77	602.75	41.6 "	4.9 "	53.5 "	....
		20	1	1,225	1868-69	South Pier	115,560	13,904	218.7	.....	3,235.68	556.16	1,312.20	.....	5,104.04	51.04	487.74	63.4 "	10.9 "	25.7 "	....
		16	10	2,700	1879-80	Southerly Br. Water	89,098	4,667	177.0	27	2,494.74	186.68	1,062.00	324.00	4,067.42	40.67	367.20	61.3 "	4.6 "	26.1 "	8.0 "
		16	11	500	1889	Southerly Br. Water	63,880	5,436	314.2	.....	1,788.64	217.44	1,885.20	.....	3,891.28	38.91	383.60	46.0 "	5.6 "	48.4 "	....
		30	12A	300	1893	Southerly Br. Water	33,420	3,800	91.3	.....	935.76	152.00	547.80	.....	1,635.56	16.36	561.79	57.2 "	9.3 "	33.5 "	....
Superstructure.	6 ft.	20	2	1,225	1893	South Pier	28,680	3,387	60.8	.....	803.04	135.48	364.80	.....	1,303.32	13.03	445.44	61.6 "	10.4 "	28.0 "	....
		16	12B	2,200	1893	Southerly Br. Water	27,540	3,272	50.4	.....	771.12	130.88	302.40	.....	1,204.40	12.04	410.67	64.0 "	10.9 "	25.1 "	....
Concrete superst.	6 ft.	30	6	95	1887	Easterly Br. Water	Blocks, cu.yds. 95	Lining, cu.yds. 8.5	Rubble, cu.yds. 267	Pink, ft. B.M. 10,050	Blocks, $950.00	Lining, $85.00	Rubble, $1,602.00	Plank, $281.40	$2,918.40	$29.18	....	....	....	....	....

Notes: To make comparison possible, between the different plans of construction, materials and cost have been calculated for the uniform height of 20½ ft. (20 courses) including stone and pile foundation where used for crib work; and 6 ft. for superstructure, and at the following prices: Timber, $28.00 per M. ft. B. M.; Dr. bolts 4 cts. per lb.; stone filling, $6 per cord; piles, driven, $12.00 each; concrete blocks and lining $10.00 per cu. yd.; rubble concrete, $6.00 per cu. yd., and plank (for support of concrete), $28.00 per M. ft. B. M.

[a] Including stone and pile foundation. Remarks: [1] Bottom side timbers 12 × 18 ins.—all others 12 × 12 ins., cribs with grillage, sunk on sand bottom; [2] Cribs suspended by chains 4 ft. above lake bottom, stone foundation 4 ft. high, 20 ft. wide (Figs. 4 and 8); [3] Stone foundation 4 ft. high, 20 ft. wide; [4] Pile foundation, bottom of cribs 2 ft. above lake bottom; [5] Ties 10 × 12 ins., long'ls, 8 × 12 ins., stone bottom 6 × 12 ins., etc.; [6] Stone foundation 6 ft. high, ties and long'ls 10 × 12 ins.; [7] Cribs 50 ft. long, ties and long'ls 12 × 12 ins.; [8] Pile foundation bottom of cribs 2 ft. above lake bottom; [9] Stone foundation 6 ft. high; [10] Ties and long'ls 10 × 12 ins., no solid end wall except at end of pier; [11] Lakeward blocks 6 ft. high, landward blocks 4 ft. high.

is due to the greater efficiency of fuel used in a stationary central plant as compared with the best modern practice with the ordinary locomotive.

With this locomotive 5 lbs. of coal are usually consumed per hour per horse-power; though lately the application of the compounding principle to locomotives has reduced the coal consumption 20 to 30%. But with a stationary plant, boilers can be used which more perfectly consume the coal; engines are designed for double and triple expansion; their efficiency is further increased by condensers; and as a consequence a large central plant can be run on a consumption of from 1¾ to 2½ lbs. of coal per horse-power hour. And further than this, stationary boilers can be adapted to the burning of cheap fine coal of an inferior quality to that required on a locomotive.

To compare the consumption of coal on city steam and electric roads, Mr. Parsons gathered the material for the following table, which shows the weight of train, including the estimated weight of passengers, and the coal consumed per train and per ton-mile, the first three being electric roads and the others steam roads

Railway.	Weight of train, tons.	Coal per tr'n mile, p'r lbs.	Coal ton-mile lbs.
Liverpool Overhead ...	42.0	17.5	.416
Intramural	74.0	36.6	.495
City and South London.	44.0	28.0	.604
Manhattan (1)	80.8	49.2	.609
Brooklyn El. Ry. (2)...	63.5	42.0	.661
Manhattan (3).....	97.1	51.3	.528
Brook yn El. Ry. (4)...	91.5	48.1	.526

Note.—(1) Ninth Ave. train with an average of 3.77 cars. (2) Short train averaging 2.74 cars. (3) All trains, averaging 4.50 cars. (4) All trains, averaging 4.55 cars.

The normal train in both New York and Brooklyn is much heavier than those of the three electric roads; and as the consumption of coal does not increase in direct proportion with the weight of train, Mr. Parsons has obtained this consumption for the lightest trains on the New York and Brooklyn lines, and these are the proper figures to use in comparing results with the electric lines. This also explains the better showing of the Manhattan 80.8-ton train over the Brooklyn 63.5-ton train. As Mr. Parsons says, these figures show a striking economy in favo. of electricity. The better showing of the Liverpool road over the Chicago Intramural is due mainly to the difference between permanent and temporary plants; and the poorer showing of the City & South London comes from the use of non-condensing engines, which it is estimated increase the coal consumption 20 to 25% over what could be obtained by a better type of engine.

THE ADOPTION OF THE METRIC SYSTEM IN THE UNITED STATES.

Progress in the present movement looking forward to the legal approval of metrical standards in the United States is reported upon as follows in the November issue of the "Journal of the Association of Engineering Societies":

At the World's Congress of Electricians at Chicago in 1893, the adoption of standard units of electrical measurement based on the centimeter, gram and second was recommended. The American Institute of Electrical Engineers petitioned Congress in the spring of 1894 to adopt those units as the legal standards in the United States, and Congress accordingly passed an act last summer establishing them. Some details were left to be attended to by the National Academy of Sciences. Among the interesting points in the debate upon the bill in the House of Representatives on June 9 were the reference to the constitutional authority of Congress to fix the standard of weights and measures, the statement that Germany and Great Britain had already adopted the electrical standards in pursuance of the recommendation of the Congress at Chicago, and the argument that the expenditures of the United States Government for electricity are now so large that it is a matter of commercial importance to establish legal units of measurement for it. Hon. Charles W. Stone, of Pennsylvania, a member of the Committee on Coinage, Weights and Measures, had charge of the bill.

In the London "Times" of Nov. 21, 1894, is the report of a general meeting of the New Decimal Association, held on the preceding day at the London Chamber of Commerce, where, after the passage of a resolution about a Select Committee of Parliament, it was voted,

That the Hon. William L. Wilson be informed of the present position of the movement in this country for adopting the metric weights and measures, and that he be urgently invited to use his influence to secure such legislation as may provide for the adoption of this system of weights and measures in the United States.

The chairman, Sir Samuel Montagu, M. P., stated that he had received promises of active co-operation from Mr. Wilson, the author of the recent Tariff bill in the United States.

CRIB CONSTRUCTION IN CHICAGO HARBOR, AND ITS COST.

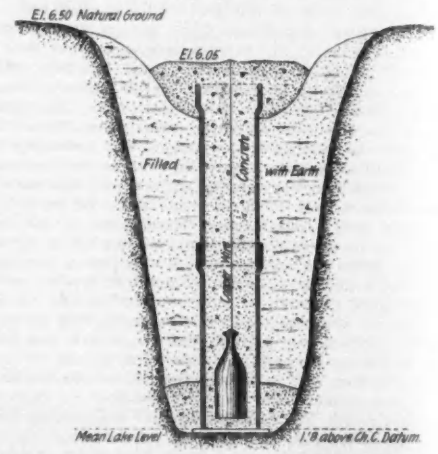
(With inset.)

In the last annual report of Capt. W. L. Marshall, Corps of Engineers, U. S. A., is given some interesting matter relating to the crib construction used in forming an outer harbor or basin at Chicago, Ill. This harbor was commenced in 1870 and is now finished, excepting 267,000 cu. yds. of dredging required to attain the necessary 16-ft. depth at low water and some work to be done on the exterior breakwater, 5,413 ft. in length. The outer basin covers an area of about 455 acres. This exterior breakwater was commenced in 1881 and was practically completed in 1890. It is a timber crib, 30 ft. wide, filled with stone; the outer 1,200 ft. section is placed on a stone foundation, but the remainder rests on the natural bottom, in water from 18 to 32 ft. deep. It was considerably damaged by a four-days' storm in May, 1894, and about $75,000 is required for repairs.

In the report of U. S. Asst. Engineer G. A. M. Liliencrantz to Captain Marshall cross-sections are given showing the various types of pier and crib construction used, and with these is the accompanying table of the relative cost of this pier-work in sections 100 ft. long and 20½ ft. high. The prices given are those for the contracts of 1893-94, and in all cases include the material secured in the work, and in the items for timber superstructure and decking the bolts and spikes are included in the price stated. Prices are given separately for timber-work, decking, etc., to facilitate their use in making estimates and to indicate the relative proportions of cost of the different parts of the work. In the items representing the cost of stone, the cribs are supposed to be filled to within 6 ins. of the top, or level with the upper faces of the cross-ties. This table was prepared with the especial purpose of facilitating the preparation of approximate estimates of cost of similar work.

The average of all the different plans shown, excluding those with pile foundations, shows that of the total cost of the work, 55.56% was for timber; 8.77% was for drift bolts, and 34.67% was for stone.

In the same report the method is described for establishing reference points to mark the site of the old U. S. lighthouse, erected at the mouth of the Chicago River on the north pier in 1865, but now removed to Twin River Point, Mich. This light was an old and well-established landmark and



Construction of Reference Points to Locate Center of Old Light House in Chicago Harbor.

the preservation of its exact location was of value and interest. Four reference points were established as follows: At the bottom of a hole about 5 ft. deep a small board was placed and on this were set two sections of 6-in. sewer-pipe. The natural ground around the bottom was packed down and a ring of Portland cement concrete was placed around the bottom of the pipe to keep it in position. A plumb-bob was then made of a quart bottle filled with wet sand and suspended from a tripod by a copper wire passing through the cork. The wire thus made an absolute plumb line in the center of the pipe, and to prevent oscillation of the bottle, its bottom was surrounded with thin grout. A dry mixture of one part cement and two parts of fine sand was then carefully sifted down the pipe until this was nearly full; then water was poured over it and allowed to pass through the mixture. When the cement and sand were saturated the pipe was filled to the top with a cement mortar of the same composition, and a ring of the same material, about 3 ft. in diameter, was formed about the top of the pipe. A small nipple of cement indicated the position of the wire, which was cut off close to the cement. These holes were finally filled with wet sand, after angles and distances had been taken

to permit future location of these reference points. Point 1 was marked by a single copper wire; Point 2 by two wires, and Points 3 and 4 by three and four wires respectively. The accompanying cut shows the method pursued.

THE COST OF HYDROGRAPHIC SURVEYS.

A statement of the cost of eleven hydrographic surveys in the District of Florida has been prepared for the use of the U. S. Engineer School at Willets Point, N. Y., under the direction of Capt. Wm. M. Black, Corps of Engineers, U. S. A., who is in charge of that department. While the cost of such surveys must vary with the amount and class of work required and the natural conditions controlling similar work, any data upon this important feature must be useful, and is especially so when coming from such competent authority.

The statement published for the School is a summary, in each case, of the more detailed records in the Reports of the Chief of Engineers. We have tabulated these controlling features as nearly as can be done for the better understanding of the general summary of cost given by Capt. Black, as follows:

General data.	St. Augustine Harbor.	St. John's Bar.	Key West Harbor.	Sarasota Bay.	Caloosahatchee R.	Manatee River.	St. John's River.*
Area surveyed, square miles	...	...	..	...	24.5	9.0	...
	9.03	6.0	14	9.0	2.5	0.6	8.0
Average width of stream, or upper river, ft.	1,800	...	..	2,000	200	250	4,000
Average width of stream, lower river, ft.	....	...	..	...	4,000	3,000	...
Av. distance between triangulation stations, miles	1.5	1.0	1.5	...	0.75	0.75	0.75
Area covered by triangulation, sq. miles	9.03	6.0	14	...	24.	9.0	8.0
Average length of sounding lines, miles	0.3	..	..	..	...	...	...
	1.5	1.5	2.5	0.5	0.75	0.75	1.0
Average interval between soundings, ft.	20	20	20	20	20	20	20
Average interval between sounding lines, ft.	500	500	800	1,000	500	500	300
Average depth of water	10.15	15	12	5	10	8-10	15
Maximum velocity of current, ft. per second	3.0	5.0	2.5	1.0	2.0	2.0	3.0
Mean range of tide in feet	4.0	4.5	2.6	1.3	1.5	1.7	1.6

* Dames' Point.

At St. Augustine the bottom was sand and Coquina gravel, while the banks were sandy beaches and marshes; in the St. John's surveys the bottom was sand; in Key West harbor it was coral, sand and rock; in Sarasota Bay, it was sand and rock; in the Caloosahatchee River it was mud and sand, and the same in Manatee River and in the St. John's at Dames' Point.

The general character of the work in each place may be given as follows: At St. Augustine a base-line was used obtained from Coast Survey records; each sounding station was sighted 12 times, and the soundings on the bar were mostly through breakers and taken in a row boat, while the inside soundings were made from a steamer. At St. John's Bar one-fourth of the soundings were in breakers on sandy shoals lying outside the two converging jetties. At Key West Harbor a 7,000-ft. base-line had to be measured through from one to three feet of water and staked at 100-ft. intervals. There were only three transit triangulation stations; the rest of the triangulation being done with the sextant. All soundings were made from the deck of a schooner while sailing, and much time was lost by bad weather. The Sarasota survey was made in a tidal estuary. The Caloosahatchee survey was made in the saw-grass region with the river banks 4 to 10 ft. high, through a country heavily wooded and with thick undergrowth. On the upper river, in the saw-grass, stadia stations were erected at intervals of 1,000 ft. for 10 miles. Then a transverse between points located by triangulation was run along the edge of the prairie and the river for about 12 miles more. The next 41 miles was a stadia traverse along the banks of the river. The estuary was triangulated; a line of levels was run for 67 miles; the elevation of water surface was taken at each traverse station and the snags and overhanging trees were counted. For the Manatee survey two base-lines were measured, and permanent triangulation stations were set up. The Lake Survey method of measuring angles was used, with each signal sighted eight times. The reconnaissance was made by stadia measurements, and the work plotted in the field. In the St. John's-Dames' Point survey two base-lines were used; one measured and the other obtained from Coast Survey records; soundings were taken from a row boat and from a steam launch and borings were made by a water-jet. Permanent triangulation stations were erected. With this general information the accompanying summary of cost can be better understood.

It should be explained of the three St. John's Bar surveys in the table, that in the second survey the old transit stations were connected by a system of triangulation, using a Coast Survey base. The average interval between sounding lines was 300 instead of 500 ft. During the third survey tide gages were set up and observed on the bar and at points between the jetties. The second Key West survey consisted only of current observations, borings and triangulation. The 7,000-ft. base line was extended 5,230 ft. in water 2 to 3 ft. deep. In the third survey soundings were taken at 500-ft. intervals between sounding lines. The working party was quartered on a schooner with a steam launch for a tender.

SUMMARY OF COST OF HYDROGRAPHIC SURVEYS—FLORIDA DISTRICT.

	St. Augustine.		St. John's Bar, 1888.		St. John's Bar, 1889.		St. John's Bar, 1890.		Key West No. 1.		Key West No. 2.		Key West No. 3.		Sarasota.		Caloosa.		Manatee.		Dames Point.	
	Item.	Rate per day.	Item.	Rate per day.	Item.	Rate per day.	Item.	Rate per day.	Item.	Rate per day.	Item.	Rate per day.	Item.	Rate per day.	Item.	Rate per day.	Item.	Rate per day.	Item.	Rate per day.	Item	Rate per day.
Total cost	$2,724.31	...	$937.32	...	$1,094.70	...	$1,538.11	...	$2,500.00	...	$1,008.92	...	$5,273.62	...	$849.09	...	$2,374.40	...	$1,304.48	...	$3,998.24	...
Office work, Total	778.90	...	266.95	...	282.05	...	288.43	...	746.77	...	149.50	...	1,394.60	...	140.00	...	787.44	...	250.76	...	728.20	...
Office work, Per cent. of total cost	29	...	28	...	25	...	18	...	29	...	14	...	26	...	16	...	33	...	19	...	18	...
Incidental, Total	$435.63	...	$173.00	...	$202.83	...	$569.17	...	$441.24	...	$200.76	...	$576.08	...	$144.00	...	$359.54	...	$257.32	...	$932.48	...
Incidental, Per cent. of total cost	15	...	18	...	18	...	37	...	17	...	20	...	11	...	17	...	15	...	19	...	24	...
Reconnaissance, Per sq. mile	.....	...	.....	...	...	...	.....	...	.....	...	.....	...	.....	...	$32.22	0.75	$205.02	0.12	$91.25	0.2	.....	...
Per lin. mile	.....	...	.....	...	.....	...	.....	...	.....	...	.....	...	.....	...	14.29	1.8	8.26	3.2	5.36	3.4	.....	...
Triangulation, Per station	$28.18	0.7	.....	...	$6.60	2.3	.....	...	$42.00	1.2	$35.29	1.2	$61.71	1	.....	...	5.10	6	4.82	2.4	$11.76	2.2
Shore lines, Per mile	4.60	2.2	$4.43	7	3.09	4.4	$3.87	4.6	1.41	5	.....	...	.....	...	.....	...	2.82	3	2.52	3.8	2.40	6.6
Sounding, Per mile	3.52	5.3	3.77	8.5	2.66	7.5	3.58	7.7	1.28	23	.....	...	1.40	27.4	.....	...	1.08	22	2.20	10	1.85	11.3
Borings, Each	3.65	3	.....	...	.....	...	.....	...	.....	...	6.12	6	6.83	8.6	.....	...	.....	...	.....	...	3.19	5
Current Obs., Per station	17.54	...	.....	...	.....	...	.....	...	28.50	...	29.21	...	67.63	...	...	...	.....	...	.....	...	15.78	...
Cost per day, Of average field party	34.23	...	41.67	...	33.17	...	35.33	...	36.42	...	32.75	...	65.22	...	25.00	...	27.67	...	25.08	...	29.73	...

Note.—The "rate per day," as we understand it, means the rate of work per day for the several items.—Ed.

SHEET ASPHALT PAVING PRACTICE IN TWELVE AMERICAN CITIES.

Mr. George Platt, City Engineer of Erie, Pa., recently sent out inquiries to various cities as to the base, binder used, cost, etc., of sheet asphalt pavements. He received replies from twelve cities, and the substance of these replies is given below.

As to the thickness of the concrete base employed, Washington uses 6 and 4 ins.; Harrisburg, Pa., 6 ins.; Scranton, Pa., 5 and 6 ins.; Pittsburg, Pa., 4, 5 and 6 ins.; Kansas City, 4 to 6 ins.; Chicago, Cincinnati, Columbus, Detroit, Cleveland, Buffalo, and Syracuse, each 6 ins. The last-named seven cities, with the addition of Harrisburg and Scranton, use broken stone only in connection with the sand and cement in the concrete. Washington uses half stone and half gravel, and Pittsburg uses broken stone and screenings. Six of the above cities use no cushion coat at all on the concrete; while Pittsburg, Chicago, Cincinnati, Columbus, Detroit, and Syracuse, each use a ½-in. cushion coat. Harrisburg, Cincinnati, Detroit, and Syracuse lay no binder course; the other cities lay one of 1½ ins. in thickness, excepting Chicago, 1 in., and Cleveland, ½ in. In six of the cities using binders the material is broken stone; in Cleveland it is sand or gravel.

The thickness of the surface after final compression is as follows: Washington, 1½ ins., or 2½ ins., loose; Harrisburg, Chicago, Cincinnati, Detroit, Columbus, Cleveland, and Syracuse, 2½ ins., including the ½-in. cushion; Pittsburg, 1½ to 2 ins.; Kansas City and Buffalo, 2 ins.

The average price paid per square yard for sheet asphalt pavements let under the most recent contracts is as follows: Washington, 6-in. base, $1.68, 4-in. base, $1.53; Harrisburg, $2.75; Scranton, $2.58; Pittsburg, 4 and 5-in., no binder, $2.49, 6-in. base, with binder, $3.06; Kansas City, $2.58½; Chicago, $2.83 to $2.93; Cincinnati, $2.75; Columbus, $2.65; Detroit, $2.50; Cleveland, $2.85 to $2.95; Buffalo, $3.00; Syracuse, $2.43. In Washington, Harrisburg, Scranton, Pittsburg, Kansas City, Chicago, Cincinnati, Columbus, Detroit, Cleveland, and Syracuse, this price does not include grading, foundation and curbing; in Buffalo, the price does include these items, but any grading exceeding 1 ft. is paid for by the cubic yard. Buffalo and Erie are the only cities including curbing in the paving price.

The items which actually are included in the above given prices, besides sheet asphalt pavement, are—Washington, base, binder, and surface; Harrisburg, grading and foundation; Scranton, all but curbing, including grading, foundation, remodelling street basins, raising or lowering manholes, crosswalk, and gratings; Pittsburg, removal of the subgrade; Kansas City, everything but curbing, if the street has been graded, if not graded, this is done first by special contract; Chicago, grading and foundation; Cincinnati, grading, rolling sub-grade, and pavement complete, no curbing; Columbus, grading and foundation, curbing, 40 cts. per lin. ft. extra; Detroit, concrete; Cleveland, concrete base only; Syracuse, includes the 6-in. concrete foundation.

The terms of guarantee for sheet asphalt pavements are as follows: For 5 years, Washington, Harrisburg, Scranton, Pittsburg, Kansas City, Chicago, Cincinnati, Columbus, Detroit, Buffalo, and this is "generally" the case in Syracuse; the Cleveland guarantee is for 10 years, and Detroit in some cases has demanded the same.

Mr. Platt gives a brief resume of the above practice as follows: First—In regard to broken stone or gravel in the hydraulic cement concrete.

All cities use broken stone alone except Washington, which uses half gravel and half broken stone. Second—In regard to the price. All cities reported above, with one exception, Buffalo, do not include curbing in the bid for asphalt pavements. The average price in the 11 cities is $2.605; adding 24 cts. per sq. yd. for curbing, the average price on a 30-ft. roadway, would make the average price, including curb, $2.845. This average of $2,605 includes Washington, which has a very low price, but says it includes "simply base, binder, and surface," the grading evidently being done under another contract or at an additional price. Third—Curbing is not included in the bid in 11 cities, and is included in one, Buffalo. Fourth—In 10 cities there is a 5-year guarantee, in one, Cleveland, a 10-year, and Syracuse reports 5 generally and 10 sometimes.

ADHESION OF CEMENT MORTAR TO BRICK.

The results of some interesting experiments on the adhesion of cement mortar to different kinds of brick have recently been presented to the Union des Ingenieurs de Louvain, France, by M. Felix de Walque, and are abstracted in "Engineering," of Nov. 16. We are indebted to that journal for the accompanying table. The characteristics of the different qualities of bricks and cements used are given in the table. The bricks were soaked in water before being cemented together and were tested at the ages of 2 days and 4 days, as well as at the ages given in the table. The results given at the ages of 2 and 4 days were very irregular, which, it will be noted, was also the case in a lesser degree with the 8½-day tests. Each experiment was repeated four times and the mean result is given in the table. Perhaps the most remarkable thing brought out by the table is the fact that the smooth-pressed bricks gave a far better hold to the mortar than the rougher varieties, which is contrary to the generally accepted belief. With more complete information regarding the nature of the cement and sand and their admixture, and further details of the tests, it is possible that this peculiar result might be accounted for.

Table Showing Adhesion of Cement Mortar to Brick at Ages of 8½, 15 and 44 Days. (All results are in pounds per square inch.)

Cement.	Sand.	Hand-made clamp-burnt stocks. 8½ days.	15 days.	44 days.	Hand-made clamp-burnt facing bricks. 8½ days.	15 days.	44 days.	Hand made clamp-burnt clinkers, place bricks, etc. 8½ days.	15 days.	44 days.	Machine-made repressed hard-burnt bricks. 8½ days.	15 days.	44 days.	Machine-made facing bricks. 8½ days.	15 days.	44 days.
Slow-setting Portland, 1 part.	½ part	17.7	54.5	37.1	17.1	26.3	36.0	14.2	35.2	32.7	36.0	34.6	36.3	34.7	21.3	16.2
	1 "	8.2	35.3	42.7	4.5	20.9	20.4	15.3	25.9	....	23.4	27.5	42.7	12.8	16.7	15.2
	2 "	10.9	17.8	27.0	7.5	11.2	18.4	10.5	14.2	19.2	13.5	29.7	25.7	11.9	13.4	15.3
Quick setting Portland, 1 part.	½ "	16.7	54.3	68.7	13.3	32.8	43.0	19.6	50.0	54.4	49.9	44.2	91.7 above 106.7	13.4	17.1	20.4
	1 "	11.5	44.4	35.5	11.0	18.1	23.1	14.2	33.6	38.9	32.3	43.8		9.9	12.8	23.6
	2 "	11.0	19.2	21.2	4.5	18.1	24.2	4.9	26.1	37.5	20.3	31.3	33.9	3.3	10.7	13.7
Slow-setting slag cement, 1 part.	½ "	7.5	42.0	38.8	10.4	14.0	29.2	14.0	28.6	33.3	20.6	34.1	45.9	10.8	16.7	19.6
	1 "	10.4	37.0	29.6	7.3	18.1	27.0	23.0	33.4	26.9	30.0	32.7	45.3	10.3	18.6	13.0
	2 "	7.1	19.2	23.4	2.9	18.1	11.8	4.5	26.1	20.1	18.1	19.5	29.2	8.6	10.6	8.7
Medium-setting slag cement, 1 part.	½ "	9.7	39.6	39.1	15.5	28.4	29.9	25.3	38.0	47.1	17.9	33.4	41.7	9.4	23.6	16.3
	1 "	10.9	35.8	26.6	5.7	12.9	20.3	19.2	25.0	26.7	19.8	26.5	32.0	9.8	16.0	27.5
	2 "	4.9	28.9	22.4	8.2	18.3	22.0	10.5	17.8	13.7	21.7	22.0	25.9	6.3	14.4	8.0
Slow-setting Portland, 1 part.	½ "	20.9	37.7	31.0	16.0	32.4	36.0	17.7	38.4	38.4	18.6	46.9	42.3	11.1	19.0	20.3
	1 "	7.3	24.7	19.9	10.3	15.6	21.7	17.8	19.0	21.3	22.8	23.9	28.4	16.3	14.9	21.3
	2 "	7.3	11.9	18.9	6.9	12.9	13.3	12.5	15.0	18.8	10.1	8.4	16.7	11.3	6.1	9.4

MONTHLY PRICES OF IRON AND STEEL IN THE UNITED STATES IN 1893-94.

In its last issue, the "Bulletin," of the American Iron and Steel Association gives a table of the monthly average price of leading products of iron and steel in the Pennsylvania markets for 1893 and 1894. This price is per gross ton of 2,240 lbs., except for bar-iron, which is quoted per 100 lbs. These monthly averages were obtained from weekly quotations, and we condense this table as follows, showing the chief fluctuations in the period named:

	1893. Jan. $	June. $	Oct. $	1894. Jan. $	June. $	Oct. $	Dec. $
Old iron T-rails at Philadelphia	18.00	16.62	14.80	13.00	11.62	11.50	12.00
No. 1 anthracite foundry pig, Philadelphia	14.50	15.00	14.20	13.37	12.50	12.50	12.50
Grey forge pig iron, at Philadelphia	13.10	13.00	12.25	11.56	10.56	10.50	10.50
" " lake ore, at Pittsburg	12.30	12.25	10.87	9.88	9.78	9.84	9.47
Bessemer pig iron, at Pittsburg	13.59	13.50	11.60	10.90	13.15	11.02	10.31
Steel rails at mills, in Pennsylvania	29.00	29.00	27.50	24.00	24.00	24.00	24.00
Steel billets at mills, Pittsburg	21.75	21.87	17.94	16.10	18.60	16.00	15.11
Best refined bar, store, Philadelphia	1.80	1.75	1.60	1.55	1.30	1.25	1.25
" " " at Pittsburg	1.59	1.52	1.40	1.30	1.25	1.15	1.10

Steel rails for delivery in 1895 are quoted at $22 per ton; Bessemer pig, at Pittsburg, was quoted at $10.25 at the end of December, and Bessemer billets were $15 per ton on Dec. 21. The bar-iron prices are for the best quality of refined bar-iron made from all-muck bars. Common qualities of bar-iron were sold for some time during this period, at Pittsburg, for one cent, and even less, per pound.

Two bills for maintaining and improving state roads have been introduced in the Pennsylvania Legislature by Senator John H. Brown. The first bill provides for an appropriation of $1,000,000 annually to aid counties in road making. A second bill provides for the election, every three years, in each county of a road supervisor, having special and scientific knowledge of road making. This supervisor is to give a bond of $10,000, and county surveyors are made eligible for the office. He shall give certificates to applicants for the position of township supervisors, after examination, and these latter shall be under bonds of $5,000, and shall receive a salary of $2 per day for a term of three years. Township supervisors are to be elected at the same time as the county supervisors, but all candidates must hold certificates as above provided. Annually, on the first Monday in March, the township supervisors in each county shall meet in convention, and by a majority vote may frame laws and ordinances for the regulations of the roads in their respective counties, provide penalties and remove road officials neglecting their duties. This convention has power to fix the salary of the county supervisor for three years, to fix the rate of wages and hours of service of road laborers, and to approve plans for road improvement. But to lay out a new, or to vacate an old road, the Court of Quarter Sessions must be petitioned as at present. The convention can levy a road tax, not exceeding 8 mills on the dollar annually, on all property in the several townships; this tax to be collected as other taxes are now collected. A property owner may acquire the right to improve the road passing his property, but he must first have the permission of the township supervisor, and the work done must be approved by this official. If so approved, a warrant may be issued to the property holder for an amount not exceeding the amount of his road tax. All supervisors shall be under oath for the faithful performance of their duties, and vacancies are to be filled as in the case of other county officers. The bill requires all conventions of supervisors to provide that American citizens and taxpayers shall have the preference in furnishing teams or materials or in laboring upon the roads. These two bills are independent of each other, and the second is the one most favorably commented upon.

WEATHER TABLE FOR NOVEMBER, 1894 (Furnished to Engineering News by the Department of Agriculture.)

Stations.	Temperature. (Deg. Fahr.) Average.	Max.	Min.	Range.	Wind. Velocity in miles per hour. Average.	Max.	Direction at time of max. velocity.	Precipitation—Rain or melted snow—inches. Total.	Heaviest in 24 hours.	No. of rainy days.
Northern Cities. Northfield, Vt.	28.4	58	—2	60	10.4	42	SW	2.58	.90	18
Portland, Me.	34.7	58	10	48	8.7	38	S	2.05	.49	13
New York, N. Y.	42.2	69	21	48	11.9	40	NW	3.83	1.21	13
Pittsburg, Pa.	40.4	74	22	52	8.0	28	S	1.80	.44	15
Chicago, Ill.	34.4	60	10	50	17.2	60	SW	1.18	.43	9
Omaha, Neb.	37.1	64	8	56	8.7	28	NW	.11	.10	2
St. Paul, Minn.	27.5	52	—2	54	9.3	40	NW	.61	.18	8
Duluth, Minn.	26.2	48	—6	54	7.0	34	NW	1.43	.36	10
Bismarck, N. Dak.	28.0	64	—9	72	11.5	54	NW	.40	.17	4
Average	33.3	61	6	55	10.3	40		1.55	.48	10
Southern Cities. Washington, D. C.	44.0	68	21	47	7.8	38	NW	1.52	.64	9
Louisville, Ky.	43.4	75	17	58	9.1	33	W	.63	.24	9
St. Louis, Mo.	42.5	73	18	55	13.3	46	NW	1.49	.94	7
Savannah, Ga.	57.6	78	31	47	7.3	38	NW	3.78	2.39	7
Kansas City, Mo.	42.2	74	13	61	9.9	35	NW	1.63	1.51	4
Jacksonville, Fla.	61.4	82	33	49	5.3	24	N	3.72	2.81	8
Chattanooga, Tenn.	47.6	72	19	53	7.3	28	NW	.54	.37	5
New Orleans, La.	60.5	79	35	44	7.5	35	NW	1.34	.83	6
Memphis, Tenn.	50.4	76	24	52	7.9	32	NW	.49	.44	3
Palestine, Tex.	59.0	82	29	53	6.1	36	S	1.90	1.58	4
Average	50.9	76	25	52	8.2	34		1.70	1.20	6
Western Cities. Helena, Mont.	41.0	71	9	62	8.5	52	W	.24	.20	3
Port Angeles, Wash.	44.2	55	29	26	4.5	29	W	5.53	1.66	22
San Francisco, Cal.	59.4	79	46	33	5.4	27	SE	.88	.88	1
Salt Lake City, Utah	45.6	64	19	45	4.4	24	NW	.28	.28	1
Santa Fe, N. Mex.	43.2	62	18	44	5.8	25	N	Trace	Trace	0
Denver, Colo.	44.8	75	5	70	7.8	60	NE	.22	.17	2
Yuma, Ariz.	68.3	92	45	47	4.9	20	N	None	None	0
Average	49.5	71	24	47	5.9	34		1.02	.46	4

Two bills for maintaining and improving state roads have been introduced in the Pennsylvania Legislature by Senator John H. Brown. The first bill provides for an appropriation of $1,000,000 annually to aid counties in road making. A second bill provides for the election, every three years, in each county of a road supervisor, having special and scientific knowledge of road making. This supervisor is to give a bond of $10,000, and county surveyors are made eligible for the office. He shall give certificates to applicants for the position of township supervisors, after examination, and these latter shall be under bonds of $5,000, and shall receive a salary of $2 per day for a term of three years. Township supervisors are to be elected at the same time as the county supervisors, but all candidates must hold certificates as above provided. Annually, on the first Monday in March, the township supervisors in each county shall meet in convention, and by a majority vote may frame laws and ordinances for the regulations of the roads in their respective counties, provide penalties and remove road officials neglecting their duties. This convention has power to fix the salary of the county supervisor for three years, to fix the rate of wages and hours of service of road laborers, and to approve plans for road improvement. But to lay out a new, or to vacate an old road, the Court of Quarter Sessions must be petitioned as at present. The convention can levy a road tax, not exceeding 8 mills on the dollar annually, on all property in the several townships; this tax to be collected as other taxes are now collected. A property owner may acquire the right to improve the road passing his property, but he must first have the permission of the township supervisor, and the work done must be approved by this official. If so approved, a warrant may be issued to the property holder for an amount not exceeding the amount of his road tax. All supervisors shall be under oath for the faithful performance of their duties, and vacancies are to be filled as in the case of other county officers. The bill requires all conventions of supervisors to provide that American citizens and taxpayers shall have the preference in furnishing teams or materials or in laboring upon the roads. These two bills are independent of each other, and the second is the one most favorably commented upon.

Fast passenger engines with ten wheels, but only four driving wheels, are being tried on the Atlantic Coast Line, the engines resembling those of the ordinary eight-wheel type, but having an extra pair of small trailing wheels, the arrangement being practically similar to that of the Chicago, Milwaukee & St. Paul Ry. engine illustrated in our issues of June 15 and Nov. 9, 1893, except that the rear driving wheels are the main drivers, as in the Philadelphia & Reading R. R. double-end express engines, illustrated in our issue of June 15, 1893. The Atlantic Coast Line engines have all wheels flanged, and swing-center trucks. The valve gear is of the shifting link type, with short eccentric rods, and an extension rod passing over the front axle connects the link block with the rocker, the rocker being in front of the main drivers. The leading dimensions are as follows:

Driving wheels, diam.	5 ft.
Truck wheels, "	3 "
Trailing wheels "	3 ft. 6 ins.
Cylinders	19 × 24 "
Boiler, straight top, diameter inside	5 ft.
Firebox, length inside	7 "

Electric traction is to be adopted on the Nantasket Beach and Warren & Bristol branches of the New York, New Haven & Hartford R. R., 7 and 37 miles long, respectively, according to report. On the latter branch it is proposed to start from the new station in Providence and carry it to Wautuppa station in Fall River, where a mile of new track will have to be built, a total distance of 21 miles. From Fall River the line will be extended to New Bedford, 14 miles; to the wharf and later to the other points in all probability. From Warren the line will be run to Bristol, four miles. The current for these lines will be supplied by power houses—one located at Warren, which will run the cars from Providence to Fall River, including the Bristol branch, and another at Westport Factory on the New Bedford line. Both open and closed cars will be used on this line.

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PERSONALS.

Mr. B. T. Bagley, a contractor, died at Staunton, Va., Jan. 3.

Mr. W. H. Leffingwell has been appointed Chief Engineer of the Midland Terminal Ry., of Colorado, vice the late Mr. Newell.

Mr. Wm. F. Williams has been appointed Superintendent of Water-Works at Annapolis, Md., vice Mr. Edward Powers, resigned.

Mr. Frank Turner, of Beacondale, Ont., has been appointed Chief Engineer of the projected Cobourg, Northumberland & Pacific Ry.

Mr. Charles E. Kemper has been appointed executive officer in the office of the Supervising Architect, Treasury Department, Washington, D. C.

Mr. Adolph Phillipi, a civil engineer in the employ of the Central Railroad of New Jersey, died at Elizabethport, N. J., at the age of 63. He was a native of Germany.

Mr. F. B. Harriman, Superintendent of the Freeport Division of the Illinois Central R. R., has had his jurisdiction extended to Fort Dodge, Ia., and will move his office to Dubuque, Ia.

Mr. W. D. Harris, of Ottawa, Ont., Chief Engineer of the Ottawa & Gatineau Valley Ry. and Pontiac & Pacific Junction Ry., has been also appointed Managing Director of both roads.

Mr. Duncan J. McKenzie has been appointed Railroad Commissioner of Wisconsin, with office at Madison, Wis., vice Mr. T. Thompson. Mr. J. C. Murphy is Deputy Commissioner.

Gen. John B. Gray, Vice-President and General Eastern Agent of the American Brake Co., was married at Evansville, Ind., on Jan. 3 to Mrs. Caroline E. Arthur, of Brooklyn, N. Y.

Mr. George C. McMichael, President of the Eureka Car Coupler Co., and formerly Division Superintendent of the Chicago, St. Paul & Kansas City R. R., died at Cleveland, O., Dec. 18.

Mr. J. M. Phillips has been appointed General Superintendent of the San Antonio & Gulf Shore R. R., with offices at San Antonio, Tex. The road is under construction and 30 miles have been completed.

Mr. Wm. Paul Gerhard, C. E., has been appointed Honorary Consulting Sanitary Engineer to the Department of Health, Brooklyn, N. Y. Mr. William S. Johnson is Sanitary Engineer, and Dr. Z. Taylor Emery is Health Commissioner.

Mr. William C. Downing, Engineer of Maintenance of Way on the Richmond Division of the Pennsylvania Lines west of Pittsburg, has been appointed Engineer of Maintenance of Way of the St. Louis, Vandalia & Terre Haute Ry. He is succeeded by Mr. R. K. Brown, with headquarters at Richmond, Ind.

Mr. Butler, Chief Engineer of the Cartagena & Magdalena Ry.., has been appointed General Superintendent, and Mr. V. D. Warren has been appointed Engineer of Maintenance of Way. Their offices are at Cartagena, U. S. Colombia. The railway was described in our issues of April 19 and June 14, 1894.

Mr. John Thorne, of Utica, N. Y., who died Dec. 30, at the age of 83, had been connected with a number of railways centering in that city, and was for many years President of the Utica & Black River R. R. He was interested also in the construction of the Utica, Clinton & Binghamton and the Utica, Chenango & Susquehanna Valley railways.

Mr. Frank H. Mills has been elected City Engineer of Woonsocket, R. I., vice Mr. Arthur H. Sweet. Mr. Mills was for nearly 12 years on the engineering staff of the city of Worcester, Mass., was an assistant engineer of the Genesee Valley R. R. and has for the last 12 years been managing engineer of Mr. John W. Ellis' office in Woonsocket.

Mr. C. H. Quereau, Engineer of Tests of the Chicago, Burlington & Quincy R. R., with headquarters at Aurora, Ill., has been appointed General Foreman at Plattsmouth, Neb., to attend to such duties and special investigations as may be assigned him by Mr. D. Hawksworth, Superintendent of Motive Power of the Burlington & Missouri River R. R.

Mr. Robert G. Bushnell, of Morristown, N. J., who died recently, was the founder of the Jersey City Steel Works, and up to 1880 was connected with the steel manufacturing firm of Park Bros. & Co., of Pittsburg, and was well known in connection with the development of the manufacture of high-grade steel.

Mr. John M. Sherrerd, who has been appointed Assistant General Manager of the Taylor Iron & Steel Co., manufacturing the Hadfield manganese steel castings and ordinary steel castings, car wheels, etc., at High Bridge, N. J., was for 13 years connected with the Troy Steel & Iron Co. and its predecessor, the Albany & Rensselaer Iron & Steel Co., as chemist, blast furnace manager and superintendent of the Bessemer plant.

Mr. A. J. Brooks, late of the Bureau of Construction and Repair, U. S. Navy Department, has resigned, says a Philadelphia press item, to accept the position of superintendent of construction at Cramps' shipyards, in Philadelphia. Mr. Lewis Nixon, the former superintendent for the Cramps, has lately resigned that office to go into the building of ships at Elizabeth, N. J., as noted in our columns, but he maintains his his connection with the Cramps Co., however, in a consulting capacity.

Mr. Edward H. Day, who died at Algiers, North Africa, on Jan. 4, was born at Bath, England, in 1833, and was well known in this country, having been at one time a professor in the Columbia College School of Mines, and a member of the New York Academy of Science. He was a specialist in physical geography, mineralogy and geology, had been associated with Professors Huxley, Ethridge, Hawkins and Owens in the work of the Geological Society, and was prominently identified with the labor of mapping out the geological formations of the southern counties of England. Under the direction of Sir John Hawkshaw he made the first geological survey for the proposed English Channel tunnel. Prof. Day came to this country in 1866 and became assayer to a Montana mining company, but the enterprise failed, and he accepted the place of instructor in the School of Mines of Columbia College.

ENGINEERING SOCIETIES.

BOSTON SOCIETY OF CIVIL ENGINEERS.—At the meeting of Dec. 19, a paper on "The Abolition of Grade Crossings was read by Mr. James W. Rollins, describing particularly the work done on the Providence and Old Colony divisions of the New York, New Haven & Hartford R. R. Mr. Chas. A. Allen also described the work done at Northampton, Mass.

AMERICAN SOCIETY OF CIVIL ENGINEERS.—The annual meeting will be held Jan. 16 and 17 in this city. On Jan. 16 the business meeting will be held, commencing at 10 a. m., and in the evening there will be a reception and supper at the Hotel Waldorf. On Jan. 17 there will be an excursion to Willets Point, where the engineering school will be visited by invitation of Col. W. R. King, U. S. Engineers. In the evening Mr. Charles E. Emery will deliver a lecture on "The Utilization of the Forces of Nature," which will be illustrated by lantern slides. F. Collingwood, Secy.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—At the recent annual meeting a committee was appointed to arrange for the holding of a series of monthly meetings for the discussion of technical questions. The committee has arranged that the first of these meetings will be held on the evening of Jan. 23, at 8 p. m., at the house of the Society, 12 West 31st St. A lecture on the history of the New York water-works will be given by Mr. Aphonse Fteley, Chief Engineer of the Aqueduct Commission, and will be illustrated by the stereopticon. The meetings to follow are to be held on the evening of the second Wednesday of each month.

CENTRAL RAILWAY CLUB.—The next, and annual, meeting will be held at the Hotel Iroquois, Buffalo, N. Y., Jan. 23, at 10 a. m. The discussion of Mr. Morford's paper on "Terminal Yards" (Eng. News, April 5, 1894) was postponed until this meeting, and the members of the Buffalo Railway Superintendents' Association have been invited to be present and participate in the discussion. The Committee on "Freight Car Door Hangers, Fasteners," etc., will make a full report, which the short time allowed them at the last meeting did not permit. Officers will be elected for the ensuing year. S. W. Spear, Secy.

WESTERN SOCIETY OF ENGINEERS.—The annual meeting of the society was held at the Grand Pacific Hotel, Chicago, Jan. 1, and the following officers were elected for the ensuing year: President, Horace E. Horton; First Vice-President, L. P. Morehouse; Second Vice-President, Thos. T. Johnston; Secretary and Librarian, Charles J. Roney; Treasurer, David L. Barnes, and Trustee, G. A. Liljencrantz. The election of officers was followed by a banquet, at which about 150 members and guests were present.

WESTERN RAILWAY CLUB.—The December meeting was held in the lecture room of the Field Columbian Museum, Dec. 18, with about 150 members in attendance. Quite an extended discussion was held on Mr. J. N. Barr's paper, "The Scrap Pile," read at the previous meeting (Eng. News, Dec. 6). This was followed by a brief discussion on M. C. B. couplers and by a paper by Mr. Wm. Forsyth on the "Heat Value of Western Coals." An abstract of this paper is given in another column. The next meeting of the club will be held Jan. 15, when a paper on "English Railway Practice" will be read by Mr. F. A. Delano, Superintendent of Freight Terminals, C., B. & Q. R. R.

ENGINEERS' CLUB OF ST. LOUIS.—At the meeting on Jan. 2, Col. E. D. Meier, President of the Heine Boiler Co., read a paper on "Chimneys and Chimney Drafts," considering the subject with special reference to modern boiler practice and American coals. Mr. S. Bent Russell, Asst. Engineer in charge of the water-works extension, explained an ingenious method recently resorted to at the new water-works inlet tower at Chain of Rocks for cutting off the timber of the old coffer-dam under water. William H. Bryan, Secy.

ENGINEERS AND ARCHITECTS' ASSOCIATION OF SOUTHERN CALIFORNIA.—This society was recently organized at Los Angeles, Cal., and will hold meetings on the third Wednesday of each month, the first meeting having been held Dec. 20, 1894. The officers for the current session are as follows: President, H. Hawgood, M. Inst. C. E.; Vice-Presidents, J. L. Preston, M. Am. Inst. A., and F. W. Wood, M. Am. Soc. M. E.; Directors, O. Morgan, M. Am. Inst. A., T. A. Eissen, M. Am. Inst. A., E. T. Wright, M. Am. Soc. C. E., and J. H. Dockweiler (City Engineer of Los Angeles); Secretary and Treasurer, F. Van Vleck, M. Am. Soc. M. E.

COMING TECHNICAL MEETINGS.

FRANKLIN INSTITUTE, PHILADELPHIA.
Jan. 11. "Advance in Naval Construction in the United States," by Horace See. Secy., W. H. Wahl, 16 South Seventh St., Philadelphia.
NORTHWESTERN TRACK AND BRIDGE ASSOCIATION.
Jan. 11. Secy., D. W. Meeker, St. Paul, Minn.
MONTANA SOCIETY OF CIVIL ENGINEERS.
Jan. 12. Secy., G. O. Foss, Helena, Mont.
ENGINEERS' CLUB OF INDIANAPOLIS.
Jan. 12. Secy., C. C. Brown.
WISCONSIN POLYTECHNIC SOCIETY.
Jan. 14. Secy., Geo. G. Mason, 144 8th St., Milwaukee.
ENGINEERS' CLUB OF KANSAS CITY.
Jan. 14. Secy., F. W. Tuttle, Baird Building.
MICHIGAN ENGINEERING SOCIETY.
Jan. 15, 16, 17. Annual convention at Lansing, Mich. Secy., F. Hodgman, Climax, Mich.
COLUMBIAN ENGINEERING SOCIETY.
Jan. 15. Secy., W. F. Hart, Washington, D. C.
WESTERN RAILWAY CLUB.
Jan. 15. Secy., W. D. Crosman, Rookery Building, Chicago.
ENGINEERS' CLUB OF ST. LOUIS.
Jan. 16. Secy., W. H. Bryan, Turner Block.
ASSOCIATION OF ENGINEERS OF VIRGINIA.
Jan. 16. Secy., J. H. Pilcher, Roanoke, Va.
IOWA CIVIL ENGINEERS' AND SURVEYORS' SOCIETY.
Jan. 16. Annual Meeting at Dubuque. Secy., Seth Dean, Glenwood, Ia.
AMERICAN SOCIETY OF CIVIL ENGINEERS.
Jan. 16. Annual meeting. Secy., Francis Collingwood, 127 E. 23d St., New York.
NEW YORK RAILROAD CLUB.
Jan. 17. Secy., John A. Hill, Temple Court, N. Y. City.
ENGINEERS' SOCIETY OF WESTERN PENNSYLVANIA.
Jan. 17. Secy., D. Carhart, Carnegie Library Building, Allegheny.
ENGINEERS' CLUB OF CINCINNATI.
Jan. 17. Secy., J. F. Wilson, 24 W. 4th St.
SOUTHERN AND SOUTHWESTERN RAILWAY CLUB.
Jan. 17. Atlanta, Ga., Secy., F. A. Charpiot, Macon, Ga.
CANADIAN SOCIETY OF CIVIL ENGINEERS.
Jan. 17. Secy., C. H. McLeod, 112 Mansfield St., Montreal.
ENGINEERS' AND ARCHITECTS' ASSOCIATION OF SOUTHERN CALIFORNIA.
Jan. 17. Secy., F. Van Vleck, Los Angeles, Cal.
ENGINEERS' CLUB OF PHILADELPHIA.
Jan. 19. Secy., L. F. Rondinella, 1122 Girard St.
ENGINEERS' CLUB OF MINNEAPOLIS.
Jan. 21. Secy., E. Nexsen, Kasota Block.
DENVER SOCIETY OF CIVIL ENGINEERS.
Jan. 22. Secy., F. Ed. King, 36 Jacobson Block.
AMERICAN SOCIETY OF MECHANICAL ENGINEERS.
Jan. 23. "History of the New York Water-Works." Secy., F. R. Hutton, 12 W. 31st St., New York city.
BOSTON SOCIETY OF CIVIL ENGINEERS.
Jan. 23. "The Use of Steel in Large Buildings," C. T. Purdy. Secy., S. E. Tinkham, City Hall, Rooms, 36 Bromfield St.
CENTRAL RAILWAY CLUB.
Jan. 23. Secy., S. W. Spear, East Buffalo Iron Works, Buffalo, N. Y.
TECHNICAL SOCIETY OF THE PACIFIC COAST.
Feb. 1. Secy., O. Von Geldern, 719 Market St., San Francisco.
CIVIL ENGINEERS' SOCIETY OF ST. PAUL.
Feb. 4. Secy., C. L. Annan, City Engineer's Office.
WESTERN SOCIETY OF ENGINEERS.
Feb. 6. Secy., C. J. Rooney, Club Room 9, Grand Pacific Hotel, Chicago.
CIVIL ENGINEERS' CLUB OF CLEVELAND.
Feb. 12. Secy., F. C. Osborn, 721 Hickox Building.
NORTHWESTERN SOCIETY OF ENGINEERS.
Feb. 12. Secy., D. W. McNorris, Burke Building, Seattle, Wash.

NEW PUBLICATIONS.

JANUARY MAGAZINES.—In the "Popular Science Monthly" there is an article entitled "Twenty-five Years of Preventive Medicine," which is an admirable summary of what the past quarter-century has seen in the way of sanitary progress. It is difficult indeed to realize that the great bulk of our modern sanitary processes, systems and devices are a modern invention, and that prior to the civil war, good sewerage and plumbing and pure water supplies were matters which the public regarded with dense apathy. The article is written in a popular style; but the work done by sanitarians and by state and municipal health officers during the past quarter-century has nowhere been better summarized. This magazine also contains a short reprint of a paper, "The Barometric Measurement of Heights," by J. Ellard Gore, an elementary paper, but one which may interest some engineer unfamiliar with this method of measuring altitudes, now much less used than formerly. In the "Review of Reviews," we find an excellent portrait of Mr. L. E. Cooley, M. Am. Soc. C. E., and a Vice-President of the International Deep Waterways Association, organized at Toronto last September; also a full-length picture of the late Ferdinand de Lesseps. There is also a well-written paper on the English labor leader John Burns, which will interest American engineers by its graphic account of the work Mr. Burns has done in connection with the municipal government of the Battersea district of London and as a member of the London County Council.

In "Harper's" we find a most remarkable and well-told story, which the relator avers to be founded on fact, concerning an exploit of a professional rainmaker at Cheyenne, Wyo., "on a certain September first." This rainmaker appears to have used the "new process," by which you entice the moisture from the heavens by ejecting some mysterious gases from a secret apparatus. That the story is probably a true one, authentic information from other sources leads us to believe. At no distant day we hope to give our readers some information concerning this new process of rainmaking, or attempted rainmaking. Julian Ralph has a long paper in this number on "Charleston and the Carolinas." It is well illustrated and gives apparently a very good picture of the progress, social and industrial, of these two commonwealths.

In the "North American Review" there is a paper by Hon. Robert E. Preston, Director of the Mint, on "The Future of Gold." It will surprise many to learn that the world's gold production is now greater than ever before in its history. The annual gold production in 1892 and 1893 exceeded even the enormous output of 1856-60, when the mines of California and Australia were at their best rate of production. In 1893 the world's stock of gold was increased about $135,500,000, of which the United States and Australia each contributed about $35,000,000, and Russia and Africa each about $27,000,000. Col. Wm. Ludlow, M. Am. Soc. C. E., who is now Military Attache to the United States embassy to the Court of St. James, writes on "Military Systems of Europe and America." The paper is a brief review of the subjects indicated by its title. The author, like most other army officers, favors a considerable increase in the standing army of the United States. Another article of interest to engineers in this issue is "Shall we Have Free Ships?" by Hon. Edward Kemble, President of the Boston Chamber of Commerce. Mr. Kemble urges free ships on the ground that America would then be able to compete for the carrying trade of the world.

In "The Century," Hiram S. Maxim describes his recent work and experiments in aerial navigation. The article is illustrated with engravings of the boiler, engines, and other machinery of Mr. Maxim's latest flying machine. This persevering inventor is either shrewdly advertising himself or else is really convinced that success is possible in the very difficult work which he has undertaken. In "The Forum," the two leading articles are criticisms of the recent report of the Chicago Strike Commission, the first by Prof. A. B. Hart, of Harvard College, and the second by Mr. H. P. Robinson, editor of the "Railway Age" Mr. David A. Wells writes on the constitutionality of the income tax, and holds that the law assessing it may yet be adjudged unconstitutional, on account of its discrimination in favor of persons with incomes below $4,000 a year. Louis A. Garnett discusses the question "Has Gold Risen?" and presents an extended argument, backed up by statistics, to show that instead of rising, the value of gold has depreciated during recent years.

USES OF COMPRESSED AIR.—By Addison C. Rand. New York: Republic Press, 14 Lafayette Place. 12mo; cloth; pp. 134; illustrated; $1.

This is the second edition of Mr. Rand's book, noted in our issue of May 17, giving a practical account of the many uses to which compressed air has been applied. It is very fully illustrated.

CONSTRUCTION NEWS.

CONDENSED LIST OF CONTRACTS PENDING WITH DATE OF OPENING BIDS.

Bids to be opened.	Work.	Place.	See Eng. News.
Jan. 12.	Hotel building,	Medford, Wis.	Dec. 13
Jan. 12.	Piles and dredging,	Portland, Ore.	Dec. 27
Jan. 12.	Pipe sewers,	Pittsburg, Pa.	Jan. 10
Jan. 12.	Paving,	Pittsburg, Pa.	Jan. 10
Jan. 12.	Water bonds ($35,000),	Canal Dover, O.	Jan. 10
Jan. 14.	Sale of iron & steel plant,	Chester, Pa.	Jan. 3
Jan. 14.	Piles,	Sioux City, Ia.	Dec. 27
Jan. 14.	Water bonds ($15,000),	Clara City, Minn.	Jan. 3
Jan. 14.	Water bonds,	Duluth, Minn.	Jan. 3
Jan. 14.	Sidewalks,	Houston, Tex.	Jan. 3
Jan. 14.	Sewers,	Brooklyn, N. Y.	Jan. 10
Jan. 14.	Brick sewers,	Jersey City, N. J.	Jan. 10
Jan. 14.	School building,	Chicago, Ill.	Jan. 10
Jan. 15.	Steam boilers, etc.,	New York,	Dec. 27
	Advertised, Eng. News, Dec. 27 and Jan. 3.		
Jan. 15.	Water-works system,	Brightwood, Ind.	Dec. 27
	Advertised, Eng. News, Dec. 27 to Jan. 10.		
Jan. 15.	Bridge superstructure,	Warren, O.	Dec. 27
Jan. 15.	Pipe sewers (23,585ft.),	Charlotte, N.Y.	Jan. 3
	Advertised, Eng. News, Jan. 3.		
Jan. 15.	High school annex,	Charleston, S. C.	Jan. 3
Jan. 15.	Roads (6½ miles),	Batavia, O.	Jan. 3
Jan. 15.	Vitrified block paving,	Washington, D.C.	Jan. 10
	Advertised, Eng. News, Jan. 10.		
Jan. 15.	Brewery,	Marion, O.	Jan. 10
Jan. 15.	Asphalt block paving,	Washington, D. C.	Jan. 10
	Advertised, Eng. News, Jan. 10.		
Jan. 15.	Village hall,	Hinckley, Minn.	Jan. 10
Jan. 15.	Station'y eng., Nat'l Soldiers' Home,	Va.	Jan. 10
Jan. 16.	Jetty,	San Francisco, Cal.	Dec. 27
Jan. 16.	Sewage pumping station,	Meadville, Pa.	Jan. 3
Jan. 16.	Grading,	Haughville, Ind.	Jan. 10
Jan. 17.	Removing shoals,	Burlington, Vt.	Dec. 20
	Advertised, Eng. News, Dec. 20 to Jan. 10.		
Jan. 17.	Brick sewers (6,142 ft.),	Providence, R.I.	Jan. 10
	Advertised, Eng. News, Jan. 10.		
Jan. 17.	Fender work,	Tompkinsville, N. Y.	Jan. 10
	Advertised, Eng. News, Jan. 10.		
Jan. 17.	Sewage pump'g station,	Providence, R.I.	Jan. 10
	Advertised, Eng. News, Jan. 10.		
Jan. 17.	Macadamizing,	Sharpsburg, Md.	Jan. 10
Jan. 17.	Wire fencing, etc., etc.,	Sharpsburg, Md.	Jan. 10
Jan. 18.	Dredging, etc.,	Philadelphia, Pa.	Dec. 27
Jan. 18.	Sidewalk bonds,	Pleasant Ridge, O.	Dec. 27
Jan. 18.	Pipe sewers (24,651 ft.),	Watertown, Wis.	Jan. 10
Jan. 19.	Water bonds ($3,500),	Elysian, Minn.	Jan. 10
Jan. 19.	Pipe sewer,	Tippecanoe, O.	Jan. 10
	Advertised, Eng. News, Jan. 10.		
Jan. 21.	Laying water pipe,	New Orleans, La.	Dec. 27
	Advertised, Eng. News, Dec. 27 to Jan. 17.		
Jan. 21.	Cast iron pipe (42 to 16-in.),	Cleveland, O.	Dec. 27
Jan. 21.	Street Ry. franchise,	Hartwell, O.	Dec. 27
Jan. 21.	Bridge bonds, ($200,000),	Toledo, O.	Dec. 27
Jan. 21.	Water-works system,	Milan, Ill.	Dec. 27
	Advertised, Eng. News, Dec. 27 to Jan. 10.		
Jan. 21.	Railway trestle (2,000 ft.),	New York.	Jan. 3
Jan. 21.	Pipe sewer,	Fargo, N. Dak.	Jan. 3
Jan. 21.	Electric light plant,	Boston, Mass.	Jan. 10
Jan. 21.	Telephone and electric plants,	Boston.	Jan. 10
Jan. 21.	Plans for filter beds,	Victoria, B. C.	Jan. 10
Jan. 22.	Electric light plant,	Melbourne, Aus.	Dec. 27
Jan. 22.	Brick sewers,	Buffalo, N. Y.	Jan. 10
Jan. 22.	Water-wks. extensions,	New York.	Jan. 10
Jan. 22.	Bridge,	Buffalo, N. Y.	Jan. 10
Jan. 22.	Pipe sewers,	Buffalo, N. Y.	Jan. 10
Jan. 22.	Pipe, lead, etc.,	New York.	Jan. 10
Jan. 23.	Electric light franchise,	Winnipeg, Man.	Dec. 6
Jan. 23.	Gas franchise,	Winnipeg, Man.	Dec. 6
Jan. 23.	Tow and dredge boat,	St. Louis, Mo.	Dec. 27
	Advertised, Eng. News, Dec. 27 to Jan. 10.		
Jan. 24.	Sale Hamilton, Ont.,	Bridge Co.'s plant.	Dec. 20
	Advertised, Eng. News, Dec. 20 to Jan. 17.		
Jan. 24.	Dredging machinery,	Portland, Ore.	Dec. 27
	Advertised, Eng. News, Dec. 27 to Jan. 17.		
Jan. 24.	Building materials,	Newark, N. J.	Jan. 3
	Advertised, Eng. News, Jan. 3 and 10.		
Jan. 24.	Water-wks. materials,	Shelby, Mich.	Jan. 10
	Advertised, Eng. News, Jan. 10 and 17.		
Jan. 25.	Asphalt paving,	Ottawa, Ont.	Dec. 27
Jan. 29.	Paving,	Cincinnati, O.	Jan. 10
Jan. 30.	Piles, brush and stone,	St. Louis, Mo.	Jan. 10
Jan. 31.	Water-wks. ext'ns,	New Orleans.	Jan. 10
	Advertised, Eng. News, Jan. 10 to 24.		
Jan. 31.	Building work,	Washington, D. C.	Jan. 10
	Advertised, Eng. News, Jan. 10 and 17.		
Jan. 31.	Steel bridge,	Providence, R. I.	Jan. 10
	Advertised, Eng. News, Jan. 10 and 17.		
Feb. 1.	Electric lighting,	Corry, Pa.	Dec. 13
Feb. 1.	Water supply	Corry, Pa.	Dec. 13
Feb. 1.	Gas plant,	Peoria, Ill.	Dec. 27
	Advertised, Eng. News, Dec. 27.		
Feb. 1.	Electric light plant,	Peoria, Ill.	Dec. 27
	Advertised, Eng. News, Dec. 27.		
Feb. 1.	Steel swing bridge,	Port Huron, Mich.	Jan. 3
Feb. 1.	Paving,	Sandusky, O.	Jan. 10
Feb. 1.	Pipe, valves, etc.,	Cleveland, O.	Jan. 10
Feb. 4.	Bridge,	Natchez, Miss.	Dec. 13
Feb. 4.	Paving bonds ($31,400),	Covington, Ky.	Jan. 3
Feb. 4.	Electric light plant,	Crowley, La.	Jan. 10
Feb. 9.	Building plans,	Dallas, Tex.	Jan. 3
Feb. 9.	Water-works extensions,	New Orleans.	Jan. 10
	Advertised, Eng. News, Jan. 10 to 31.		
Feb. 11.	Jail,	Beaumont, Tex.	Dec. 13
Feb. 15.	Stone dam,	Holyoke, Mass.	Dec. 13
	Advertised, Eng. News, Dec. 13 to Jan. 24.		
Feb. 19.	Torpedo boats,	Washington, D. C.	Dec. 6
Feb. 20.	Water bonds ($25,000),	Kamloops, B. C.	Jan. 10
No date.	Water supply,	Columbus, Ga.	Jan. 10

RAILWAYS.

East of Chicago.

ATLANTIC & LAKE SUPERIOR.—This company took possession of the Baie des Chaleurs Ry. Jan. 1 and will complete the line to Paspebiac without delay, according to reports. The road is projected from Metapedia to Paspebiac, Que., 100 miles, of which 80 miles have been completed. The Atlantic & Lake Superior is projected from Gaspe, Que., to Sault Ste. Marie, Ont., 1,172 miles, of which a total of 556 miles were completed a year ago.

GLOVERSVILLE & BROADALBIN.—J. W. Cleveland, representing the Kennyetto Construction Co., has offered to build a railway from Broadalbin to Gloversville, N. Y., connecting with the Fonda, Johnstown & Gloversville road if the right of way and $10,000 are given. The new road would be 4½ miles long and is estimated to cost $45,000.

EMPORIUM & RICH VALLEY.—This railway has been extended from Bustard Hollow to Robinson Run, Pa., and it is stated that a further extension of eight miles to Clermont, Pa., is contemplated.

LOGGING.—The Marquette, Mich., "Journal" states that R. G. Peters will at once build a logging railway from Grayling, 18 miles, into the heart of a lot of pine timber owned by him. It is expected that 80,000,000 ft. will be carried over the road for the owner. There is also a large amount of pine owned by other people tributary to the road.

LONG ISLAND.—Work on an extension of this railway from Bridgehampton to Easthampton is reported as progressing rapidly, and the contract for extending the line from Easthampton to Amagansett has just been awarded to Holmes & Coogan, Jersey City, N. J., the work to be completed by April 1.

NEW YORK, NEW HAVEN & HARTFORD.—This company is reported about ready to begin the construction of the four-track system through the city of South Norwalk, Conn. The work will require the elimination of several expensive grade crossings and taking the streets under the tracks, besides the building of two passenger stations to cost between $30,000 and $40,000.

PENNSYLVANIA.—A press report from Johnstown, Pa., states as follows: The survey of a branch of the Pennsylvania R. R. into the northern part of Somerset county has been completed and the work of construction will be commenced during the present month. From what can be learned from the engineer corps it is the intention of the company to head off the Pennsylvania Midland road by the immediate construction of a circular line of railway, which will extend from Lovett, on the South Fork branch of the Pennsylvania to Scalp Level, thence to Foustwell, where a junction with the branch of the Baltimore & Ohio will be effected. The construction of such a line means that the Pennsylvania people intend to hinder in every way the construction of the Midland road, and in order to accomplish this, the company has obtained options on a large amount of land in the vicinity, which comprises about 900,000 acres. The drawings and map of the new line have been given to the constructing engineers, with orders to push the work as rapidly as possible. The proposed circuit includes within its bounds great tracts of coal lands, which will be developed at once. It is also stated that the Pennsylvania company will shortly begin the survey of a line to penetrate the southern part of Somerset county, but this matter has been held in abeyance until the proposed branch, as mentioned above, is completed.

PITTSBURG & EASTERN.—The stockholders of the three projected roads, the Loyalhanna & Youghiogheny, the Philadelphia & Pittsburg, and the Pittsburg & Eastern have agreed to merge the three lines into one, their interests being identical. The consolidated company will be known as the Pittsburg & Eastern, and the work of construction will be commenced in the spring. When completed, the line will extend from West Newton, Pa., on the Youghiogheny River, where it will connect with the Vanderbilt lines, to a connection with the Beech Creek road, another Vanderbilt line, at Mahaffey. Press reports state that people identified with the Loyalhanna Coal & Coke Co. are the largest stockholders in the consolidated lines.

ROCKPORT & CHATTANOOGA.—The Northwestern Construction Co. is reported to have been awarded a contract to build a railway from Rockport, Ind., to Chattanooga, Tenn., the construction to be commenced immediately.

Southern.

AVOYELLES, ST. LOUIS & SOUTHWESTERN.—About eight miles of grading has been completed on this railway, and it is expected that the line will be completed to Bunkie, La., this week, after which the track will be laid.

BALTIMORE & OHIO.—Press reports state that this company has completed the purchase of the Monongahela branch in West Virginia, extending from Fairmont to Clarksburg, a distance of 30 miles, and that it is also said to have made a deal by which the Baltimore & Ohio gets possession of the West Virginia & Pittsburg, which extends from Clarksburg to Camden, a distance of 100 miles. This gives the Baltimore & Ohio a direct line from Pittsburg to that point. The plan is to extend the line from Camden to Charleston, through the interior of West Virginia, where it will connect with the Chesapeake & Ohio, giving the Baltimore & Ohio a direct line through the most valuable coal and timber section of West Virginia.

GEORGIA NORTHERN.—The incorporation of this railway was noted last week. It is stated that this is a reorganization of the Boston & Albany, and that an extension will be built from Pidcock southwest to Madison, Ga., about 25 miles. Address J. N. Pidcock, Jr., Jersey City, N. J.

GLENDON & GULF.—It is reported that this railway is to be extended from Glendon southwest to Troy, N. C., about 30 miles. Supt., Frank D. Jones, Glendon, N. C.

MURFREESBORO & WOODBURY.—This proposed railway, noted last week, will be 20 miles in length. Surveys will be made at once, and the construction commenced as soon as possible. Track and rolling stock are reported to have been purchased. Dr. J. E. Thompson, Murfreesboro, Tenn., is the chief projector.

RABUN GAP.—This company is being organized at Knoxville, Tenn., to build the proposed railway from Knoxville through Rabun Gap to connect with the Port Royal & Western Carolina road. The plan includes a 12-mile extension around Knoxville and a line to the Jellico coalfields. Col. Albert E. Boone, Zanesville, O., is interested.

SILVER SPRINGS & WESTERN.—Incorporated in Florida, according to reports, to build a railway from Ocala to Silver Springs, six miles; directors, Frank A. Teague, Alex. McIntyre, R. L. Anderson, Geo. McKay and H. L. McKay, all of Ocala, Fla. It is proposed to operate the road this year with steam motors and afterwards by electricity.

TENNESSEE CENTRAL.—Press reports state that the construction of this railway will be resumed at Kingston, Tenn., this week, and the grade completed to Harriman in 90 days. Robt. Gamblll has the contract for constructing the stockade, which is being built at the Margraves spring, across Clinch River from Kingston. The contract for grading the line from Crossville to Kingston, 43 miles, is said to have been awarded to Thompson Bros. There will be a 600-ft. tunnel between Crossville and Kingston. Pres., Jere Baxter, Nashville, Tenn.

TUNNELTON, KINGWOOD & FAIRCHANCE.—This narrow gage railway was sold to Geo. C. Sturgiss, J. A. Martin and other stockholders last week, according to reports. The road extends from Quinelton to Kingwood, W. Va., about 10 miles, and will be changed to standard gage and probably extended.

Northwest.

ASHLAND TERMINAL.—At the annual meeting at Ashland, Wis., Jan. 3, it was decided to build 18 miles of railway this spring. The officers were elected as follows: Pres., J. W. Cochran; Treas. and Man., Thomas Barden; Secy., R. C. Heidlauff. A resolution was passed authorizing the secretary to open a stock subscription book at once. The survey has been made, nearly all the right of way secured, and it is intended to begin laying the rails not later than April.

CENTRALIA & CHESTER.—It is stated that five miles have been graded to Rosborough, Ill., on the extension from Sparta south to Percy, a distance of nine miles. Ch. Engr., H. W. Schmidt, Sparta, Ill.

CHICAGO & CARBONDALE.—Incorporated in Illinois to build a railway from a point on the Chicago, Paducah & Memphis, in Williamson county, to Carbondale, Ill., with several branches; principal office, East St. Louis, Ill.; capital stock, $300,000; directors: William L. Huse, St. Louis; John J. McLean, Hillsboro; John W. Griswold and Jas. H. Attersbury, Litchfield; A. G. Brown, St. Elmo; W. S. Carter, St. Louis, and Rodney Kelly, St. Elmo.

CHICAGO, IOWA & MINNESOTA.—Organized at Alden, Ia., Dec. 27, to extend the Chicago, Iowa & Dakota road to the northern part of Iowa, probably to Clarion and Britt; Pres., Judge Porter, Eldora; Vice-Pres., F. B. Rogers, Britt; Treas., T. I. Birdsall, Alden; Secy., M. J. Furry, Alden. Considerable stock has already been subscribed, and it is stated that a preliminary survey will be made as soon as the weather will permit.

MERRILL, ANTIGO & EASTERN.—The county board of Langlade county, Wis., has voted to bond the county for $57,500 to aid in the construction of this railway, $37,500 to be paid when the road reaches Antigo, and the balance when it reaches Lake Michigan.

ODELL, HOT SPRINGS & WIND CAVE.—It is reported that the grading and bridging of this railway is completed from the Odell siding on the Fremont, Elkhorn & Missouri Valley road branch, from Buffalo Gap to Hot Springs, S. Dak., one mile to Odell City, which is to be standard gage. From Odell City the survey is completed for a narrow gage road, on a maximum grade of 4%, leading up a canyon, and around the famous Battle Mountain, connecting with the Burlington & Missouri River, at Hot Springs, S. Dak. This portion of the line is about 10 miles long, and passes 18 sandstone quarries. A survey has been made for a branch on a 3% grade, leaving the Odell City and Hot Springs line three miles form Hot Springs, extending to Wind Cave, eight miles. Of this cave there has been explored underground, 94 miles. Ch. Engr., J. M. Baldwin, Hill City, S. Dak.

RICE LAKE, DALLAS & MENOMINEE.—The Wisconsin Construction Co., noted last week as incorporated, is reported as to build the proposed extension of this railway from Cameron to Menominee, and it is stated that another construction company will be organized to build a road running south from Hayward, Wis., and still another for a road from Superior to Hayward. Geo. Fuller and S. E. Hall, of St. Paul, and M. P. Barry, of Rice Lake, Wis., were incorporators of the Wisconsin Construction Co.

SUPERIOR & EASTERN.—J. D. Cameron, Gen. Man., Sheboygan, Wis., writes us that funds have been provided for building 100 miles of this projected railway northwest from Sheboygan. The entire length of the road will be 325 miles. A meeting of the directors will be held at Sheboygan Jan. 10. Ch. Engr., G. W. Sturtevant, Chamber of Commerce Bldg., Chicago.

Southwest.

GEORGETOWN & GRANGER.—The contract for grading the first five miles of this railway has been awarded to Allison & Morris and a large force of men is reported as at work on the line. Contracts for two other sections of the road have been awarded and it is expected that the entire line to Georgetown, Tex., will be ready for the ties by Feb. 15. Work on the Trinity, Cameron & Western, through Davilla, Cameron, Hearne, Madisonville and Trinity, will probably be commenced at an early date.

GULF, COLORADO & SANTA FE.—Press reports state that Judge H. C. Caldwell, who appointed the receivers of the Atchison, Topeka & Santa Fe, has approved the proposed extension of this line from Fort Worth, Tex., to the coal fields in Jack county, and that a loan of $1,000,000 has been arranged to carry forward the project to immediate completion. Other officials however deny the reports of the proposed extension.

TEXAS WESTERN NARROW GAGE.—This railway is projected from Houston to Presidio del Norte, Tex., 600 miles, of which 52 miles, from Houston to Sealey, have been completed. The road was offered for sale Jan. 1, and as the highest bid was $13,000, the sale was postponed until Feb. 5. It is stated that the franchises of the company in Houston are worth $350,000.

WICHITA FALLS.—This company has been granted authority to issue $250,000 in bonds. The road will be about 20 miles in length, and the contract for the construction was noted last week.

Rocky Mt. and Pacific.

SAN DIEGO, PACIFIC & EASTERN.—Incorporated in California Jan. 2 to build a railway 100 miles in length; capital stock, $1,000,000, of which $100,000 has been subscribed; incorporators, H. L. Story, E. O. Van Norman, Jos. S. Bachman, John W. Cook, and J. M. Dodge, of San Diego, Cal., and Chas. Heartt and Geo. F. McCullogh, of Los Angeles, Cal., and others.

SAN PETE VALLEY.—This railway was described in our issue of Dec. 20. Surveys for the extension to Salt Lake City are progressing rapidly. Ch. Engr., O. R. Young.

UNION PACIFIC, DENVER & GULF.—Frank Trumbull, Receiver, has given formal notice that this company will not use the Denver & Rio Grande tracks between Pueblo & Trinidad, Colo., 92 miles, after six months, and it is stated that the construction of the new line will be pushed as rapidly as possible. It is stated that the work will not be done by contract.

WEISER & IDAHO NORTHERN.—This projected railway was described last week. Leonidas Merritt, Pres., Duluth., Minn., writes us that the capital for the construction has been pledged, and that contracts will be let as soon as traffic contracts, now pending, are signed. It is expected to commence the construction this year.

Foreign.

MEXICAN INTERNATIONAL.—The construction of a branch from Reata to Monterey has been commenced, according to reports.

MEXICO.—A press report from Batopilas, Mex., states that the government has granted a concession to a syndicate of New York capitalists for the building of a railway from that rich mining district to some point on the Mexican Central, a distance of about 200 miles. Ex-Gov. Alexander Sheperd, a millionaire mine owner of Batopilas, is the leading member of the syndicate.

RIO GRANDE.—It is reported that this short railway, which runs from Brownsville to Point Isabel, in Texas, is to be extended in a direct line to Monterey, Mex. Jose Celaya, Pres., has been in Monterey for several days, and it is reported he has made the necessary financial arrangements for the building of the road.

SWEDEN.—A railway about 1,200 miles in length and uniting the northern and southern parts of Sweden has been recently opened. It runs from the famous mining district of Gallivera, in the north, to Malmoe, in the extreme southern part of Sweden, and is operated by the State.

STREET AND ELECTRIC RAILWAYS.

BOSTON, MASS.—The Newton & Boston St. Ry. Co. has secured a location for its electric line on the Newton boulevard to connect with the West End St. Ry.

HULL, MASS.—The Hull Electric Ry. Co. has been granted a franchise.

TYNGSBORO, MASS.—The granting of a franchise for an electric railway to Lowell is being discussed.

WILLIAMSTOWN, MASS.—It is reported that an electric railway will probably be built between this place and North Adams in the spring. The necessary capital has been subscribed.

HARTFORD, CONN.—Press reports state that preliminary steps have been taken by the New York, New Haven & Hartford R. R. Co. for the equipment of two short lines of its system with electric motors next summer. The two lines are the Nantasket Beach and the Warren & Bristol.——The Westport & Saugatuck Horse R. R. Co. has petitioned for permission to change its name to the Westport & Saugatuck St. Ry. Co. and to equip its line with electricity.

NORWALK, CONN.—The Norwalk St. Ry. Co. has petitioned the legislature for authority to extend its lines within this city, and to New Canaan, Wilton, Saugatuck, Westport, Gregory's Point, Compo Beach, Green's Farms, Southport and Wilson's Point. Pres., Ebenezer J. Hill.

SENECA FALLS, N. Y.—The Waterloo, Seneca Falls & Cayuga Lake Ry. Co. has been granted a franchise to construct its electric line on the new boulevard from Easton Farm to Cayuga Lake Park and Orchard Beach.

WALDEN, N. Y.—The Walden & Orange Lake Electric Ry. Co. has been granted a franchise. Work on the line will soon be commenced.

ATLANTIC CITY, N. J.—Press reports state that an ordinance has been introduced into the council for an electric railway on South Carolina Ave. to the Inlet, and westward to Arctic Ave. and Arctic Ave. to the Inlet, and westward along Arctic Ave. to Chelsea, paralleling the Pennsylvania R. R.'s electric line on Atlantic Ave. John J. Gardner, Joseph Thompson, Levi Albertson and I. G. Adams & Co., of this city, are interested.

TRENTON, N. J.—The Trenton Traction Co. has been incorporated with a capital stock of $500,000, with full amount paid in, to construct and operate street railways and electric and other power plants; incorporators, E. J. Moore, Philadelphia; Thos. C. Barr, East Orange, N. J.; F. M. Eppley, West Orange, N. J.; Geo. B. Jenkinson, Newark; Wm. S. Stryker, F. W. Roebling, J. L. Kuser and H. H. Hamill, Trenton.

BOYERTOWN, PA.—R. Shaner, Pottstown, is making surveys for extending the Ringing Rocks electric railway to Falckner Swamp.

GREENSBURG, PA.— Press reports state that Judge Sadler, of Carlisle, has been in this place in the interest of the Greensburg, Turtle Creek & Pittsburg Electric Ry. Co., and says that if the company secures the right of way through Jeannette the road will be commenced at once and completed in six months.

NORRISTOWN, PA.—Shepp Bros. are making arrangements to construct an electric railway in the spring from this city to Ambler, according to reports.

PHILADELPHIA, PA.—The People's Traction Co. is reported about to construct an electric railway from the present terminus on Girard Ave. along the Aramingo Canal to Frankford.

BALTIMORE, MD.—Evans & Co. have been awarded the contract by the Baltimore & Catonsville Construction Co. for building the Edmondson Ave., Catonsville & Ellicott City Electric Ry. from Baltimore to a point 1½ miles beyond Catonsville, a total distance of 5¾ miles. The White-Crosby Co. was the only other bidder. Evans & Co. will begin work in a few days, and the contract calls for a completion of the line within 90 days. Davies Murdoch, of Evans & Co., is reported as stating that the firm will do all the grading, lay the rails, string the overhead wires, build the powerhouse and car-barn, and furnish ten cars. The railroad will be a single track, with turnouts wherever needed. It is understood that as soon as the railway is completed to Catonsville its extension to Ellicott City and points beyond will be undertaken. B. N. Baker, Pres. Baltimore & Catonsville Construction Co.; W. L. Layfield, Secy. Edmonson Ave., Catonsville & Ellicott City Ry. Co.

ELKTON, MD.—The Maryland Clay Co. is reported as preparing to build a cable railway from the pits to the washers, a distance of a half a mile. The cars will hold two tons of clay.

WASHINGTON, D. C.—Edmund Saxton has been awarded the contract for constructing the Ninth Ave. line of the Metropolitan St. Ry. Co. The Buda-Pesth underground system will be used. Work will be commenced at once, and the line is to be in operation by Aug. 2.

ASHEVILLE, N. C.—The Asheville & Biltmore St. Ry. Co. has been granted a franchise to construct a railway two miles in length, according to reports.

CHARLESTON, S. C.—Julian Fishburne has petitioned for an extension of time in which to commence the construction of an electric railway. A charter has been granted by the legislature, and a company will at once be organized.

ATLANTA, GA.—E. B. Rosser, H. T. Dayton and J. R. Collins have petitioned for a franchise to construct an electric railway in certain highways and also to the exposition grounds.——W. A. Hemphill and G. S. Lowndes have petitioned for a franchise to build an electric line to the exposition grounds.

OCALA, FLA.—F. A. Teague, R. L. Anderson and H. L. McRay are interested in the Silver Springs & Western R. R. Co., which proposes to connect this city with Silver Springs, a distance of six miles. It is reported that steam motors will be used the first year, and afterward electricity.

NEW ORLEANS, LA.—Surveys are being made for a suburban railway to connect with the New Orleans City and Lake R. R. in St. Bernard Parish. J. T. St. Alexander and H. T. Beauregard are interested.

AKRON, O.—Press reports state that the Akron St. R. R. Co. has filed a mortgage for $600,000 in favor of the Central Trust Co., New York, to secure the issue of 20-year 6% bonds to that amount. The money will be used to construct electric roads to Cleveland, Kent and Barberton, covering a distance of 57 miles.

CANTON, O.—The citizens have petitioned the Canton Electric St. Ry. Co. to extend its line on Navarre and other streets. Pres., William Lynch; Dr. Shanks has been circulating the petition.

CLEVELAND, O.—H. H. Gilbert, Lorain St., has a plan for building an electric railway for the purpose of carrying freight to the west side and reduce cartage rates.

ELYRIA, O.—The Elyria, Oberlin & Wellington Electric R. R. Co. has been incorporated with a capital stock of $100,000, by A. R. Webber, W. A. Braman, R. T. Reefy, A. H. Johnson, Parks Foster and others.

NORTH AMHERST, O.—H. G. Redington and A. Stinald are reported as securing right of way for an electric railway between this place, Lorain and Oak Point. It is thought that the line will be in operation in a year.

STEUBENVILLE, O.—The construction of an electric line from Steubenville through Wintersville, Richmond and Amsterdam, passing midway between Harlem Springs and Carrollton, a distance less than 30 miles, to New Philadelphia, is being discussed. It is reported that surveys will be made in the spring. The power houses will be made to furnish electric lights. John Kilgore is interested.

WELLSTON, O.—H. M. Gates, Ch. Engr. Wellston & Jackson Belt R. R. Co., writes us that a line is being located for an electric railway to pass through Wellston, Glen Roy, Coalton, Jackson and other towns, a distance of 32 miles. Work will begin as soon as the weather permits. The company is not yet ready to let contracts. Pres., Harvey Wells.

ALEXANDRIA, IND.—The Madison County Belt Ry. Co. has been incorporated with a capital stock of $150,000, by C. A. McNair, T. A. Meysenburg, G. T. Cran and J. L. Blair.

ANDERSON, IND.—Press reports state that C. L. Henry, representing a company of capitalists who are working in opposition to the Clodfelter (New York) syndicate in putting in the Belt Electric Line reaching from Indianapolis to Alexandria, has secured a franchise for electric lines in Pendleton and Alexandria. They are already in charge of the Anderson line, which gives them a clear road from the center of Indianapolis to the center of Marion, a distance of 80 miles, and also from Alexandria to Elwood, a distance of 15 miles.

INDIANAPOLIS, IND.—The Indianapolis, Greenwood & Franklin Ry. Co. has been granted a 50-year franchise for an electric line on Madison road, work on which will be commenced at once.——It is reported that a company will soon be organized to build an electric railway on the National road from this city to Plainfield, a distance of 14 miles. There is talk of building an electric line to Noblesville.

DETROIT, MICH.—The Citizens' St. Ry. Co. has petitioned for permission to equip its Grand River Ave. line with electricity. The contract for 116 cedar poles has been awarded to H. M. Loud & Co., Oscoda. Contracts have also been let for 245 iron poles and 15 new motors. The company has a franchise to extend the line on Griswold St., Grand River Ave. to Woodward Ave., which will be constructed in the spring.

GRAND HAVEN, MICH.—An ordinance is to be introduced in the council authorizing the construction of a street railway, which must be changed to an electric line within two years.

CHICAGO, ILL.—The Chicago St. R. R. Co. is about to build a one-story brick car barn at 1991 to 2003 West Madison St., estimated to cost $75,000, and a one-story brick electric power house at 47 Western Ave., estimated to cost $120,000.——A one-story brick power house on Roscoe Boulevard to cost $150,000 and a two-story brick car barn on Elston and Warner Aves., estimated to cost $35,000, are to be built by the Chicago Electric Transit Co.

KENOSHA, WIS.—Press reports state that there is some talk about another attempt being made for a franchise for an electric railway in Kenosha. The present plan will be more extensive than previous ones, since it is proposed to make Truesdell one of the limits, and thus connect the city with the St. Paul road. Mr. Wheeler, who is connected with the waterworks system, is supposed to be interested and has talked the question over with the citizens. It is thought that the St. Paul company and the United States Express Co. might take some interest in securing a franchise of this sort. Mr. Wheeler, it is said, has gone to New York to see Mr. Miller, Pres. of the St. Paul road.

ST. PAUL, MINN.—The North St. Paul Ry. Co. is to be reorganized and its electric railway will probably be extended from White Bear to Stillwater.

DES MOINES, IA.—The Des Moines City Ry. Co. has petitioned for permission to carry mail, express and freight over its line to the brick plants and coal mines. Pres., J. S. Polk.

CARTHAGE, MO.—It is reported that an electric railway is being constructed between this place and Carterville. The line will probably be extended to Joplin to connect with the electric railway at that place. The company having charge of this project secured a charter from Carthage, and also obtained a bonus of $15,000 from the citizens. The expectations are that the road will be completed and in operation by July. It is intended to make this part of a system under contemplation that will unite all the mining camps of Jasper county.

HOT SPRINGS, ARK.—The Hot Springs Inclined Ry. Co. has been incorporated with a capital stock of $300,000, to construct a railway from this city to the summit of West Mountain, work on which will commence in 30 days. Pres., Col. S. W. Fordyce; Vice-Pres., G. W. Baxter; Treas., Henry Rhorer, St. Louis.

FORT WORTH, TEX.—It is reported that the Fort Worth St. Ry. Co. is to extend and relay its line with 56-lb. steel rails, estimated to cost $50,000. Supt., George Hendricks.

SEATTLE, WASH.—The entire property of the Rainier Power & Ry. Co. has been sold to creditors for claims of over $25,000. The company will be reorganized.

LOS ANGELES, CAL.—The council has granted a franchise to the Los Angeles Electric Ry. Co. for equipping its horse and cable lines with electricity. W. D. Larrabee is interested.

PHOENIX, ARIZ.—The council has granted a franchise for an electric railway, according to reports.

ELECTRIC LIGHT AND POWER.

BOSTON, MASS.—Bids are asked until Jan. 21 for an electric light plant, a telephone system and speaking tubes for the Boston city hospital. E. M. Wheelwright, Cy. Arch.

SARANAC LAKE, N. Y.—It is reported that this place is soon to be lighted by electricity.

EAST ORANGE, N. J.—The township committee will petition the legislature for authority to build an electric light plant.

RIVINGTON, N. J.—An election will be held Feb. 20 to decide the question of adopting electric lights.

KUTZTOWN, PA.—The Trustees of the Kutztown normal school have voted to put in an electric light plant.

PHOENIXVILLE, PA.—It is reported that the Schuylkill Valley Illuminating Co. is desirous of vacating the present building, the lease of which soon expires, and is looking for a better location.

TAMAQUA, PA.—An election will be held Feb. 15 to vote on the question of constructing an electric light plant, estimated to cost $25,000, according to reports.

WASHINGTON, D. C.—Press reports state that a New York syndicate has under consideration the erection of a water storage dam immediately below the government dam at the great falls of the Potomac River, and by means of a canal 2,000 ft. in length to deliver water to wheel pits 82 ft. deep on the Virginia side of the river and transmit the power to Washington and Baltimore. Should the plans of the syndicate be carried out, work will begin in the spring. Frank W. Hawley, Vice-Pres. Cataract General Electric Co., Pittsford Farms, N. Y., is interested.

ATLANTA, GA.—The machinery committee of the cotton states and international exposition has decided to put in a plant of from 3,000 to 5,000 HP. to light the buildings and furnish power for the machinery. J. H. Allen, Business Man. of "Dixie," Chn. Com.

CROWLEY, LA.—Bids are asked until Feb. 4 for the construction of an electric light plant, including an engine, dynamos and 22 arc lights. P. J. Chappius, Mayor.

SPENCERVILLE, O.—An election is to be held Jan. 12 to vote on the question of issuing $12,000 in bonds for an electric light plant.

KNIGHTSVILLE, IND.—An electric light plant is to be put in at this place by Brazil capitalists, according to reports.

LOWELLVILLE, O.—William L. Erskine, Clk. of Corporation, writes us that no definite action has yet been taken by the council in regard to an electric light plant. A committee is figuring on the requirements and cost, and it is likely that a plant will be put in.

HOWARD CITY, MICH.—It is reported that the council is considering the question of purchasing the electric light plant put in by Mr. Andrews.

AURORA, ILL.—The Aurora Gas & Electric Co. contemplates making improvements in its plant which will cost $50,000.

CHICAGO, ILL.—The Western Electric Co. has been granted a permit to construct a one-story brick addition at 269 to 275 South Clinton St., estimated to cost $17,000.

JACKSONVILLE, ILL.—Press reports state that the council has voted to erect and maintain a municipal electric light plant. The contract has been awarded to the Excelsior Electric Co. of Chicago, at $19,960. The Standard Electric Co. was also represented.

QUINCY, ILL.—The Empire Electric Light & Power Co. has petitioned for a franchise. H. O. Channon is interested.

KEOKUK, IA.—A proposition to light this city and adjoining places with electricity is noted under Carthage, Ill., item under Bridges.

DODGEVILLE, WIS.—It is reported that a company is being formed to put in an electric light plant estimated to cost $5,000.

FERGUS FALLS, MINN.—Moorhead parties have applied for a franchise for an electric light plant, according to reports.

DICKENSON, N. DAK.—Ed. Hughes, Bismarck, is interested in a project for putting in an electric light plant in this city.

PAWNEE CITY, NEB.—It is reported that the city clerk has been directed to advertise for bids for the construction of an electric light plant.

SPRINGDALE, ARK.—This place will probably have electric lights, according to reports.

SEATTLE, WASH.—H. C. Henry, G. F. Gund, R. R. Spencer and E. H. Ammidown are interested in a scheme to develop the water power of Cedar River at a point 20 miles from Pioneer Place and to transmit electricity to this city; estimated cost, about $165,000. T. A. Noble and Stixrud & Nastem have been preparing the estimates.

SACRAMENTO, CAL.—The South Yuba Water Co. has been granted a franchise to transmit 4,000 HP. to this place within two years from its reservoirs and canals near Newcastle.

NEW COMPANIES.—Fulton Electric Light & Power Co., Fulton, Ill.; $20,000; C. C. McMahon, H. S. Remer.

Mutual Electric Light Co., San Francisco, Cal.; $500,000.

Knoxville Electric Co., Knoxville, Ia.; $20,000; J. H. Auld, W. O. Robinson.

Combination Power Co., Chicago, Ill.; $400,000; John E. Anderson, J. T. Dyer, L. J. Blades.

California Electric Light & Power Co., California, Mo.; $6,000; W. H. Mengee, J. P. Gray, F. W. Sarman.

Parkesburg Electric Light, Heat & Power Co., Parkesburg, Pa.; $10,000, with $1,000 paid in; Treas., A. J. Williams.

Electric Bell & Resistance Co., Newark, N. J.; $10,000, with $1,000 paid in Geo. F. Atwood, Orange; James P. McKenna, Newark.

Detroit Electric Lighting Co., Detroit, Mich.; $50,000; Chn., Wm. R. McGraw; Vice-Chn., L. C. Sherwood; Secy., Leopold Godfrey; Treas., I. T. Cowles.

Farquhar Electric Co., Boston, Mass.; $1,000,000, with $50,000 paid in; to manufacture electrical machinery; W. C. Farquhar, C. W. Whitcomb, A. J. Boardman.

Gerson Electrical Mfg. Co., Philadelphia, Pa.; $50,000, with $5,000 paid in; to manufacture iron or steel and electrical appliances; Treas., Charles Heritage, 2420 Poplar St.

Cushman Electric Co., Saco, Me.; $30,000, with $300 paid in; to manufacture electrical machinery; Pres., B. A. Kimball, Concord, N. H.; Treas., Ambrose Eastman, Boston, Mass.

Cartersville Light & Power Co., Cartersville, Ga.; $100,000, with $25,800 paid in; P. W. French, Weymouth, Mass.; F. P. Symonds, Salem Mass.; W. E. Merrill, Haverhill, Mass.; F. M. Smith, Lynn, Mass.; J. H. Turnbull, Boston.

Kings County Electric Light & Power Co., Jersey City, N. J.; $1,000,000, with $1,000 paid in; to manufacture electricity for light, heat and power in Brooklyn, N. Y.; Edwin C. Law, First Ave., cor. 81st St., Brooklyn; H. P. Burr, Amityville, N. Y.; H. G. Adams, Montclair Heights, N. J.

Clear Creek Gold Mining & Water Power Co., Denver, Colo.; to secure the gold supposed to be on the bed of Clear Creek, for 13 miles around Golden, and to supply electricity for operating all kinds of machinery in Denver, a distance of 15 miles; Pres., Henry Levis, Philadelphia, Pa.; Vice-Pres., Scott J. Anthony; Treas., E. W. Rollins; Secy., Dr. W. G. Smith, Denver.

BRIDGES.

BOSTON, MASS.—The transit commission gave a public hearing Jan. 10 to those interested in the new bridge across the Charles River between Boston and Charleston. Geo. G. Crocker, Chn.

PROVIDENCE, R. I.—Bids are asked until Jan. 31 for a steel highway bridge, as stated in our advertising columns. Robt. E. Smith, Comr. Pub. Wks.

ALLENTOWN, PA.—It is reported that the Allentown & Lehigh Valley Traction Co., on account of excessive tollage paid the New St. Bridge Co., spanning the Lehigh River, between Bethlehem and South Bethlehem, has decided to erect a new bridge, either in conjunction with the two towns or independently, if terms cannot be agreed upon. The bridge would be about 2,000 ft. long. The Traction Co. will arrange to meet the councils of both Bethlehem and South Bethlehem soon and is anxious to begin the work not later than spring.

BUFFALO, N. Y.—Bids are asked until Jan. 22 for the construction of the proposed iron bridge over the Scajaquada Creek on Niagara St., the estimated cost of which is $8,300. R. G. Parsons, Secy. Bd. Pub. Wks.

NIAGARA FALLS, N. Y.—At a meeting of the directors of the Niagara Suspension Bridge Co., held last month, the question of rebuilding the bridge was discussed but no definite plans agreed upon. Pres., Geo. L. Burrows, Saginaw, Mich.

PHILADELPHIA, PA.—It is proposed to construct a bridge across Frankford Creek at Wyoming Ave., estimated to cost $80,000, and a bridge under the North Pennsylvania R. R., estimated to cost $12,000.——The contracts for the steel work of the new bridge on Sixth St. over the Reading railway tracks has been sublet by Jones, Pollard & Co. to the Shiffler Bridge Co. The work will include a steel girder 123 ft. long and weighing 52,000 lbs., according to reports. The bridge will cost about $70,000.

PITTSBURG, PA.—The Aspinwall Land Co. is interested in a new bridge, which it is stated will probably be built this year across the Allegheny River to the new borough of Aspinwall; estimated cost, $275,000 to $300,000. Pres., Henry Warner.

SCRANTON, PA.—It is reported that a new bridge, probably iron or steel, will be built across the Tunkhannock Creek, near the residence of T. G. Walter.

ATLANTA, GA.—The county commissioners are reported about to advertise for bids for a bridge across the Chattahoochee River.

MURFREESBORO, TENN.—The Woodbury & Murfreesboro R. R. Co. is reported as receiving bids for four steel bridges to be built on its new road. Pres., Dr. J. E. Thompson.

TOLEDO, O.—L. P. Harris, Cy. Clk., writes us that the following bids were received June 7 for constructing the Perry St. bridge over Swan Creek:

Variety Iron Works, Cleveland O.	$31,027
Wisconsin Bridge Co., Milwaukee, Wis.	31,070
Toledo Bridge Co., Toledo	$29,500 to 37,000
Massillon Bridge Co., Massillon, O.	29,750
Ohio Bridge Co.	30,270
Milwaukee Bridge & Iron Co., Milwaukee	37,280

FRANKFORT, IND.—Bids will soon be asked by the county commissioners for a new bridge at Washington St., this city; bids to be asked for a brick and stone arch bridge and also for an iron bridge.

DETROIT, MICH.—A notice has appeared in the "Official Gazette," at Ottawa, announcing that at the coming session of Parliament an application will be made for an act enabling the Canada-Michigan Tunnel Co. to construct a bridge over Detroit River, as well as a tunnel under it. The draws of the bridge will, it is said, be made 1,000 ft. wide, and other things are promised in the way of non-interference with navigation. In order to construct such a bridge, permission would also have to be secured from Congress.

CARTHAGE, ILL.—A press report from this city states as follows: J. C. Hubinger, a capitalist of Keokuk, Ia., has prepared a scheme which will revolutionize the business affairs of this (Hancock) county. He says that if the city will grant him a contract to light Keokuk with electricity for 20 years he will agree to build a high bridge to extend from Fourth St., in that city, to the Illinois bluff at Hamilton, over a mile distant, the bridge to cost $400,000. He will, if properly encouraged, put a railway track on this bridge and run an electric car line across, extending the lines to Carthage, Warsaw, El Vaston and Nauvoo, thus giving those towns freight, mail and passenger service and also supplying them with heat and light.

CHICAGO, ILL.—The Carnegie Bridge Co. has been incorporated; capital stock, $100,000; incorporators, John C. Fleming, Wm. H. Eaton and P. W. O'Brien.——The commissioner of public works has reported that a viaduct on California Ave., from Kinzie St. to Grand Ave., would cost $484,200 and a subway from Kinzie St. to Grand Ave. $426,600; also that a wooden swing bridge across the river at Lawrence Ave. would cost $11,500 and a fixed span $10,000.

COLUMBUS, WIS.—The contracts for four small bridges in this town have been awarded to the Wisconsin Bridge & Iron Co., Milwaukee.

GALVESTON, TEX.—The Toledo Bridge Co., through W. J. Sherman, Contr. Engr., has offered to build the proposed steel railway bridge across the bay and have it completed within six months from the time the plans and specifications are agreed upon.

DENVER COLO.—The mayor has signed the contract with the Youngstown Bridge Co. to build the 38th St. bridge for $16,000.——Plans have been prepared for a new $50,000 bridge over Cherry Creek on Broadway.

ONTARIO, ORE.—It is reported that the agitation is being renewed for a county bridge over the Snake at Ontario. It would from $8,000 to $10,000, and would help Malheur county's trade with Idaho.

HAMILTON, ONT.—Bids were received until Jan. 10 for the masonry for the new swing bridge over the Beach Canal. The bridge will be 263 ft. in length with 161½ ft. over the canal end and 101½ over the land end.

BUILDINGS.

BIDDEFORD, ME.—The city building was burned Dec. 30, causing a loss of $100,000, including $50,000 on the building. It was built by the city in 1850 and was of brick, three stories in height.

LOWELL, MASS.—The Whittier Cotton Mills is reported about to increase its capital stock from $75,000 to $300,000 and to build a new mill in Georgia.

BROOKLYN, N. Y.—It is stated that a new storage warehouse is to be erected on the water front at Bridge St., especially designed for the storage of loaded freight cars. The management will be in the hands of a company, capitalized at $1,000,000, and the New York Central, Central of New Jersey and the Delaware, Lackawanna & Western railway companies are said to be interested in it. A feature of the warehouse will be huge elevators by which loaded cars can be lifted to any floor for unloading or for storage without breaking bulk. The building is to be larger than any other warehouse in the country and will be constructed of fireproof material. Work on the new building will begin as soon as the remainder of the capital stock is subscribed.

BUFFALO, N. Y.—Green & Wicks, Archs., are preparing plans for a 12-story building of steel construction to be built at the northeast corner of Main and Perry Sts. The estimated cost is $250,000. Capt. Alexander Clark, F. P. Gordon and H. C. French, of Buffalo, are interested.——The Presbyterians at Parkside, in the eastern part of the city, have bought a lot and are contemplating erecting a church to cost $60,000 or $70,000.

NEW YORK, N. Y.—Plans have been filed by Egan & Hallecy, of 294 Columbus Ave., for three five-story brick flats to cost $105,000.

NEW YORK, N. Y.—It is stated that ground will be broken on Sixth Ave., from 18th to 19th Sts., in May, for a department store to be 200 × 500 ft. and six stories high, estimated to cost $1,250,000. Henry

Siegel, of Siegel, Cooper & Co., Chicago, and G. Siegel, of New York, are interested in the syndicate.

CAMDEN, N. J.—Jos. B. Van Sciver & Co. are reported about to construct the largest furniture factory and warehouse in the world. The building will be seven stories high and will have a tower.

NEWARK, N. J.—The board of education is taking steps to secure a new high school building which is estimated to cost $250,000, not including the site.

WINSLOW, N. J.—The Rosedale Mfg. & Improvement Co. is securing subscriptions to its capital stock, and is reported about to commence the erection of its plant.

NEW CASTLE, PA.—It is stated that the contract for the erection of the Shenango Glass Works will be let within two or three days. The framework will be of steel, the sides of corrugated iron and the floors fire proof.

PHILADELPHIA, PA.—The Fidelity Mutual Life Association has secured a permit for a 12-story building estimated to cost $600,000. Arch., Fred S. Newman.——Angus S. Wade, Hale Bldg., is reported to have prepared plans for a $2,000,000 hotel building to be built on South Broad St., between Spruce and Pine Sts., for Robt. Goelet, of New York.

PITTSBURG, PA.—Chas. Bickle, Arch., has nearly completed plans for a $180,000 department of public safety building to be erected on Sixth Ave. The building will be six stories high with a hall on the sixth floor capable of seating 2,300 people.

WASHINGTON, D. C.—Bids are asked until Jan. 31 for steel and iron work, etc., for the U. S. post office building in this city, as stated in our advertising columns. Chas. E. Kemper, Acting Supervising Arch.——Paul D. Connor, McLean Bldg., has secured a permit for a $250,000 opera house to be built on the site of the Blaine mansion, and bids are now being received for tearing down the old building, according to reports. Archs., Wood & Lovell, Ellsworth Bldg., Chicago.

ALABAMA CITY, ALA.—The Dwight Mfg. Co., of Boston, Mass., is reported about to build a 25,000-spindle cotton mill at this place. The plans include 500 houses for operatives and three additional mills to be built later.

BIRMINGHAM, ALA.—The commercial club has secured $100,000 of subscriptions for the immediate erection of a cotton mill. H. B. Comer is said to be principal stockholder.

ATLANTA, GA.—The following bids were received by the Treasury Department, Washington, D. C., for the erection and completion of U. S. Government Building for the Cotton States and International Exposition in this city, the work to be completed by July 1:

S. Lamad, agent, Atlanta, Ga	$28,608
Marrow Bros., Baltimore, Md	34,150
Sanford & Brooks, Baltimore, Md	49,975
B. R. Paggett, Atlanta, Ga	38,997
Gude & Walker, Atlanta, Ga	33,975
Heidenrich & Co., Chicago, Ill	59,917
William W. McAfee, Atlanta, Ga	27,446
F. H. Peck, Atlanta, Ga	39,910
L. L. Leach & Son, Chicago, Ill	39,333
R. D. Cole Mfg. Co., Newnan, Ga	40,250
Miles & Bradt, Atlanta, Ga	31,500
George W. Corbett, Washington, D. C	40,687
Thomas H. Stanley & Co., New York	39,197
Emory F. Dodsen, Minneapolis, Minn	31,709
Nicholas Ittna, Atlanta, Ga	33,665
Ansen Wilson, Cincinnati, O	37,000
Joseph J. Churchyard, Buffalo, N. Y	49,440
General Contracting Co., Atlanta, Ga	33,934
Grace & Hyde Co., Chicago, Ill	32,867
Richardson & Burgess, Washington, D. C	39,642

LOUISVILLE, KY.—The Cleveland, Cincinnati, Chicago & St. Louis Ry. Co. is reported to have secured a site for a large freight depot in this city.

MARION, O.—Bids are asked by the Marion Brewing & Bottling Co. until Jan. 15 for the erection and completion of the company's building in this city. F. J. Schultz, Secy.

TOLEDO, O.—Elevator B of the Dayton & Michigan Ry. Co. was destroyed by fire Dec. 29, causing a loss of about $150,000 on the building.

ANNA, ILL.—The center building and south wing of the Southern Illinois Hospital for the Insane was burned Jan. 4, causing a loss of $300,000.

CHICAGO, ILL.—Bids are asked until Jan. 14 for the erection of a 17-room school building at the corner of California Ave. and Fulton St. Address the Committee on Buildings, Board of Education.——L. Kiper & Sons have had plans drawn by Henry Ives Cobb for an eight-story and basement factory at Peoria and Congress Sts. to cost $80,000.——E. C. S. Holmboe has made plans for a $45,000 apartment building on Dearborn Ave., near Lincoln Park.

CHICAGO, ILL.—Wirt D. Walker is reported about to erect large office and store building at the southwest corner of Wabash Ave. and Van Buren St.——Architect Kenerel is reported as making plans for a seven-story store and apartment building to be erected at West Adams and Sheldon Sts., at a cost of $200,000.——The Albert Schwill Co., of Cincinnati, has purchased six acres between 104th and 105th Sts. and the Fort Wayne and Lake Shore railways, and will erect an elevator and nine-story malt house at a cost of $400,000 to $500,000.

DECATUR, ILL.—The Chicago "Times" states that James Millikin will erect a six-story office building in this city, at a cost of $100,000. Archs., W. W. Boyington & Co.

FLINT, MICH.—W. A. Paterson is reported as about to contract for a five-story addition to his plant. Arch., P. F. Cleveland.

ASHLAND, WIS.—The legislature will be petitioned for authority to issue $75,000 in bonds for a city hall, according to reports.

DAVENPORT, IA.—The committee has recommended that the contract for the new city hall be awarded to the Morrison Mfg. & Constructing Co., Pueblo, Colo., at $70,300 or $71,350 for Portage stone, or $63,000 or $63,396 for a building of brick with stone trimmings.

HINCKLEY, MINN.—Bids are asked until Jan. 15 for the erection of a village hall. Andrew Stone, Village Recdr.

DENVER, COLO.—A committee of the chamber of commerce is reported as negotiating for a site for a convention building to seat 12,000, which it is proposed to build with a view of having one or more of the national political conventions held here in 1896.

WATER-WORKS.

TOPSHAM, ME.—The citizens are reported as agitating the question of a new water supply.

MANCHESTER, N. H.—The commissioners have voted to ask for authority to issue $200,000 in bonds for improvements and extensions.

MORRISVILLE, VT.—The village has voted to purchase the present works, in addition to the new works under construction.

NORTH ADAMS, MASS.—Prof. D. M. Green, Troy, N. Y., has prepared plans for constructing two new reservoirs, one on Broad Brook and another on the Notch.

DARIEN, CONN.—J. B. Rider, Norwalk, Conn., is president of a company organized to put in works, and it is stated that bids for the construction are being considered.

RIDGEFIELD, CONN.—The contract for works is reported to have been awarded to the Connecticut Pipe Co., New Haven, at $47,224.

FORT PLAIN, N. Y.—The commissioners have contracted for the land and water supply of North Creek and for a site for a reservoir. Bids will probably be asked within a few days for the construction of the new works.

LANCASTER, N. Y.—It is reported probable that the question of works will soon be voted on. The Depew & Lancaster Water-Works Co. was incorporated a few years ago, and has put in works at Depew, but the service has not been extended to this place.

MIDDLETOWN, N. Y.—Chas. H. Smith, Cy. Engr., writes us that the proposed extensions are those that have been under discussion for two years, but that no action has yet been taken.

MONTGOMERY, N. Y.—Several engineers have presented estimates to the citizens. It is stated that a pumping system could be put in for $19,000 or a gravity system for $30,000.

NEW YORK, N. Y.—Bids are asked by the department of public works until Jan. 22 for pipe, castings, lead, etc., and for laying mains in several streets.

PAWLING, N. Y.—It is stated that $35,000 in bonds have been voted for works.

POTSDAM, N. Y.—C. O. Tappan and R. M. Kirby are members of a committee appointed to investigate the question of a new water supply.

WELLS BRIDGE, N. Y.—It is reported that works will be put in.

JERSEY CITY, N. J.—The council is considering new specifications for a water supply.

ELIZABETHTOWN, PA.—The Elizabethtown Water Co. has been incorporated to put in works; capital stock, $20,000, of which $2,000 is paid in; Pres., Dr. H. K. Blough; Treas., Abraham G. Heisey.

HALIFAX, PA.—J. J. Rouch, Secy., writes us that an election will probably be held Feb. 19 to vote on an issue of bonds for works; supply from Armstrong Creek; population, 700.

HAZLETON, PA.—The Hazleton Water Co. was incorporated Jan. 8; capital stock, $50,000, with $5,000 paid in; Treas., David G. Baird, Beverly, N. J.

PHILADELPHIA, PA.—The council has voted to lay water pipe in about 18 streets.

POCOMOKE CITY, MD.—A franchise has been granted to Wm. J. Young, of Easton, Pa.

WHEELING, W. VA.—Gil Brown is preparing plans for the new water and electric light plant at Elm Grove.

COLUMBUS, GA.—Bids are asked for supplying the city with water in accordance with resolutions which include the following: A new 500,000,000-gallon storage reservoir is needed, also a 24-in. supply conduit, increased pressure, filtered water supply, better distribution system and extension of the service to parts of the city now without fire protection. M. M. Moore, Clk.

ALGIERS, LA.—The question of works is being discussed by the business men.

NEW ORLEANS, LA.—Bids are asked until Jan. 31 for furnishing and laying 22,000 ft. of 8 and 6-in. pipe, with hydrants, etc.; and until Feb. 9 for 33,000 ft. of 30 to 6-in., as stated in our advertising columns. L. H. Gardner, Supt.

WHITE CASTLE, LA.—It is stated that works will be put in as soon as sufficient money is secured. G. M. Bowie is mayor.

UNIONTOWN, KY.—It is reported that Col. Sanders, of Louisville, has been asked to submit estimates for works.

ASHLAND, O.—The plans and specifications for works prepared by J. B. Strawn, Salem, O., were adopted by the city council Jan. 3. Bids will soon be asked for material and labor for the construction of the works.

CANAL DOVER, O.—Bids are asked until Jan. 12 for the purchase of $35,000 in water bonds. J. A. Barry, Chn. Finance Com.

CLEVELAND, O.—Bids are asked until Feb. 1 for 563 ft. of 48-in. wrought steel water pipe, 250 4-in. and 12 6-in. fire hydrants, 42 to 4-in. water gates, 3,250 cast iron stop-cock boxes, etc. J. H. Farley, Dir. Pub. Wks.

CONVERSE, IND.—C. M. Blue, Clk., writes us that specifications for works have been completed and are open to inspection by contractors; supply from wells; population, 1,800; Engr., W. B. Ray, Logansport, Ind.

INDIANAPOLIS, IND.—The Indianapolis Water Co. is reported about to spend $100,000 for new pumping engines and other improvements.

DECATUR, MICH.—The contract for works is reported to have been awarded to Mann & Andrews, of Dowagiac.

SHELBY, MICH.—Bids are asked until Jan. 24 for pumping engine, pipe, and other materials for constructing works, as stated in our advertising columns.

Engr., Geo. C. Morgan, Chicago. C. E. Abraham, Village Clk.

LOWELLVILLE, O.—Wm. L. Erskine, Clk., writes us that a committee is securing estimates for works and an electric light plant, one or both of which may be put in soon; population, 1,000.

CHADWICK, ILL.—E. M. Humbert, Village Clk., writes us that the contract for constructing works has been awarded to Fairbanks, Morse & Co., Chicago, at $4,876. The U. S. Wind Engine & Pump Co. was the only other bidder.

CHICAGO, ILL.—A site has been selected for a new West Side pumping station.——Bids will be asked within a few days for pipe for an extension from the 68th St. pumping station to South Chicago.——The mayor has approved an ordinance authorizing an issue of $500,000 of certificates for extensions.

WOODSTOCK, ILL.—Geo. W. Field, Cy. Clk., writes us that the following bids were received for constructing works, to consist of 6,800 ft. of 8-in. pipe, 12,000 ft. of 6-in. pipe and 41 hydrants, complete:

Challenge Wind Mill & Feed Mill Co.	$14,900
C. & I. Iglehart, Morgan Park	14,658
Sam'l I. Pope Co., Chicago (awarded contr.)	14,560

FONDA, IA.—Specifications for works were completed last week, according to reports. M. G. Coleman, Recdr.

FORT MADISON, IA.—The works have been sold at auction to Alexander New, representing the bondholders, for $41,000. The plant was sold to satisfy a judgment for $254,313 in favor of the Central Trust Co., New York.

STUART, IA.—G. W. Cox has secured subscriptions sufficient to lay a main through the business portion of the city, according to reports, and the work has been commenced.

ELYSIAN, MINN.—Bids are asked until Jan. 19 for the purchase of $3,500 in 6% water bonds. C. F. Johnson, Pres. Council.

GOTHENBURG, NEB.—Chas. A. Morell, Village Clk., writes us that the new works are estimated to cost $7,000. The bonds have not yet been sold, and no bids have been asked for the construction; supply from artificial lake; population, 1,000.

YANKTON, S. DAK.—The council is reported about to spend $5,000 for a new air-lift pump.

OMAHA, NEB.—The receivers of the water company are reported as contemplating extensions and improvements that will cost over $200,000.

RUSHVILLE, NEB.—The tank of the water-works was burned Dec. 29. The tank was empty at the time.

ST. LOUIS, MO.—The contract for the boilers and settings for high-pressure station No. 1 at Bissell's Point has been awarded to the Leary Boiler Co., of Oil City, Pa., at $34,000; estimated cost, $45,000. The bids are given under Contract Prices.

BELTON, TEX.—Press reports state that the people are determined to have an improvement in the water service and if the company which has leased the works from the city for a term of years will not make the improvement, then a strong effort will be made to have the lease canceled and let the city again assume control. In this event it is probable the artesian wells will be abandoned and water pumped from the Leon River.

COLEMAN, TEX.—The attorney-general has approved the issue of $15,000 of water-works bonds.

FORT WORTH, TEX.—The contract for the Clear Fork dams has been awarded to Smith & Bardon, Fort Worth, the lowest bidders.

WEIMAR, TEX.—The council has voted to submit the question of works to a vote of the people in April.

GRAND JUNCTION, COLO.—The citizens have voted to issue the $200,000 to $300,000 in bonds for new works. S. C. Mullin, Cy. Clk., writes us that the supply will be from a mountain lake 26 miles distant.

CORVALLIS, ORE.—The council has voted to withdraw the call for bids for water bonds, noted last week.

COLTON, CAL.—The city has sold $64,000 in 6% water bonds to N. W. Harris & Co., Chicago, at par.

LONG BEACH, CAL.—The Bouton Water Co. has contracted with Fred Holbrook, Los Angeles, to lay 16,400 ft. of pipe from the company's artesian well, four miles north of town. The contract for the pipe has been awarded to the Los Angeles Rolling Mill. It is stated that the pipe will be of double riveted steel, with a double coat of asphaltum and will be 15 ins. in diameter.

RIVERSIDE, CAL.—A receiver has been appointed for the Riverside Water Co.

KAMLOOPS, B. C.—Bids are asked until Feb. 20 for the purchase of $25,000 in 25-year 5% water bonds. M. J. McIver, city clerk's office.

VICTORIA, B. C.—Competitive plans will be received by the council until Jan. 21 for filter beds to filter 3,000,000 gallons of water a day, according to reports, a premium of $500 to be paid for the best.

IRRIGATION.

VERNANGO, NEB.—Press reports state that construction on the Perkins county canal is almost at a standstill, by reason of the failure of the ditch company to make the sale of the $90,000 bonds voted to the company by Perkins county. Work has been done to the amount of $22,000, but only a very little of this work has been paid for.

HURON, S. DAK.—The state engineer of irrigation has located two artesian wells in Spink county—one in Olean township and one in Benton township. Capt. Forsett is reported as stating that many applications have been received for the location of artesian wells.

MONTANA.—Press reports state that many irrigation canals are being commenced in Montana. The El Dorado canal, taking water from the north bank of the Teton River, is 10 miles long, 15 ft. wide on top, 12 ft. wide at the bottom, carrying 2 ft. of water. The president of the company, in a late interview, estimated the capacity of the canal at 12,000 miner's inches. He says there are between 30,000 and 40,000 acres under the canal, the soil being a gravelly loam, and that the ditch can water nearly all of the land.

SAN ANTONIO, TEX.—It is reported that an ir-

rigation company has been organized for the purpose of re-establishing the old Espada irrigation system of ditches, which were built here about a century ago by the Spaniards. Pres., Alex. Watson, Jr.; Vice-Pres., J. B. Shavana; Secy. and Treas., Charles Hodson.

DELTA, COLO.—F. C. Larzon, Pres. Delta County Water Co., writes us that plans have been made for a tunnel four miles long from Uncompahgre Valley to the Gunnison River for irrigation purposes. No contract has yet been awarded. The canal is estimated to cost $300,000. Work will not begin before spring. The best electrical machinery and air compressors will be required, as it will be about all rock work. Engr., Richard Whinnereh, Ouray, Colo.

LOS ANGELES, CAL.—H. E. Huntington is reported as interested in a scheme for the construction of a system of canals, the main canal branching from the Majave River four miles from Daggett, to be used for irrigating about 240,000 acres in the Mojave desert. Four miles of main canal and seven miles of laterals have been constructed. It is proposed to spend $300,000 or $400,000 on more work. Water power will also be secured for Mineola, a new town owned by the company.

SALT LAKE CITY, UTAH.—The Snake Valley Land & Water Power Co., organized in 1893 by J. A. Melville, J. E. Ray and Col. F. H. Holloway, with a capital stock of $500,000, has about completed a reservoir two miles long and one-half mile wide in Millard county for irrigation purposes. It is the intention of the company, according to reports, to construct canals to carry the water over the Snake Valley.

WINNIPEG, MAN.—Ex-Mayor Lucas is interested in the Springbank Irrigation Co. which proposes to irrigate 60,000 of the 100,000 acres owned by the company in Western Alberta, at an estimated cost of $100,000.

SEWERAGE.

HYDE PARK, MASS.—The construction of a system to be 17,489 ft. in length and estimated to cost about $80,000 is being discussed.

MARLBORO, MASS.—The mayor has recommended that the sewer system be extended this year. D. J. Callahan, Clk.

QUINCY, MASS.—The mayor in his annual message has recommended that the system be inspected and improved. W. W. H. Bass, Clk.

WOBURN, MASS.—Arrangements are being made by the commissioners to commence the construction of a system early in March. Specifications for materials are being made, and an appropriation of $30,000 will be asked to begin the work.

PROVIDENCE, R. I.—Bids are asked until Jan. 17 for constructing a screen chamber and pump wells, and foundation walls for pumps, engines, engine house, boiler house, boilers and a pile and concrete foundation for a chimney in section No. 4, disposal division; 967 ft. of 78-in. circular sewer, average cut 20.3 ft.; 800 ft. of 48-in. circular sewer, either in open trench or tunnel, with appurtenances, average depth below mean high water 37.5 ft.; 30 ft. of 62 and 50-in. double sewer, average cut 18 ft.; 2,160 ft. of 62-in. circular sewer, average cut 16.5 ft., and 2,185 ft. of 62-in. circular sewer, average cut 15 ft., as stated in our advertising columns. Robt. E. Smith, Comr. Pub. Wks.

BRIDGEPORT, CONN.—The committee estimates that $16,500 will be needed for sewers and repairs during the year, and has recommended an additional appropriation of $22,750 for a sewer to drain a portion of the East End.

ROCKVILLE, CONN.—E. S. Henry, mayor, has urged that work on the system be pushed, for which it is stated that $150,000 in bonds will be issued.

BROOKLYN, N. Y.—Bids are asked until Jan. 14 for constructing sewers in five subdivisions of Map S. A. T. White, Comr. Cy. Wks.——A. T. White, Comr. Cy. Wks., reports that there were 22.91 miles of sewers built last year, making a total of 457.17 miles.

BUFFALO, N. Y.—Bids are asked by the board of public works until Jan. 22 for the construction of a 66 to 34-in. brick sewer, and a 20 to 12-in pipe sewer in South Ogden St. and the southeast side of Mineral Springs Road, from Buffalo River to a point 150 ft. northeast of Seneca St., with outlet and gate for same; also a 54-in. brick and 10-in. pipe sewer in the southeast side of Mineral Springs Road, from the proposed sewer in South Ogden St. and Mineral Springs Road to a point 568 ft. northeast of same. R. G. Parsons, Secy. Bd. Pub. Wks.——The council has directed the board of public works to prepare plans and specifications and to advertise for bids for the construction of sewers in Kensington Ave. The estimated cost of the work is about $10,000.

CLINTON, N .Y.—A. M. Scripture, Engr., New Hartford, has recommended the construction of 7,387 ft. of sewers, estimated to cost $5,959. J. I. Scollard, Chn. Com.

KENMORE, N. Y.—The business men's association has been discussing the question of constructing a sewer estimated to cost $250,000 to $300,000. A plan has been prepared for an outlet sewer 18,000 ft. in length to the Niagara River.——The city of Buffalo has granted this place authority to empty its sewage into the Buffalo sewers until June 1.

JERSEY CITY, N. J.—Bids are asked until Jan. 14 for constructing about 2,000 ft. of 36 to 24-in. brick sewers; 200 cu. yds. rock excavation. G. T. Bouton, Clk. Bd. St. Comrs.

ALTOONA, PA.—It is reported that the question of sewage disposal will soon be discussed by the council. Harvey Linton, Cy. Engr.

PITTSBURG, PA.—Bids are asked until Jan. 12 for constructing 24 to 15-in. pipe sewers in 26 streets. E. M. Bigelow, Dir. Dept. Pub. Wks.

READING, PA.—Press reports state that the latest proposition for the location of a site on which to pump the house sewage, as soon as the system is completed, is Fritz's island, quite a large body of land in the middle of the Schuylkill River, several miles below this city. E. Chamberlain, Cy. Engr., favors this location, as it is 13 ft. above the ordinary high-water mark, and it is proposed to erect a stone guard to protect it from freshets. The committee regards this site very favorably, and Mr. Chamberlain has been directed to prepare a report on the subject embodying his recommendations.

BALTIMORE, MD.—The commission, consisting of Mendes Cohen, F. H. Hambleton and H. T. Douglas, has recommended an appropriation of $20,000 to be used in perfecting plans and employing an engineer to examine the plans for a system.

MACON, GA.—The construction of a system in Vineville, a suburb of this city, is being discussed.

JACKSONVILLE, FLA.—Geo. E. Waring, Jr., New York, has recommended the construction of a pumping station at Victoria and Adams Sts. for a small district that cannot be sewered directly into the St. John River, and the construction for the rest of the city of 303,120 ft. of 18 to 8-in. pipe sewers, estimated to cost $112,816; cast iron outlet pipe, 1,925 ft., $1,304; cast iron force main, 775 ft., $924; siphon main, 4,925 ft., $2,793; 218 manholes, 306 flush tanks, 2 siphon wells and 2 pump wells with pumps. The system is estimated to cost $161,434. A. W. Cockrell, Jr., Secy. Bd. Trustees.

NEW ORLEANS, LA.—The New Orleans Sewerage Co. has awarded the contract for constructing the system for this city to Steward & McDermott, New York. Work was commenced on this system in April, but on account of difficulties only 800 ft. on Robertson St. was constructed. It is said that the work will be resumed at once and pushed to completion.

TIPPECANOE, O.—Bids are asked until Jan. 19 for constructing an 18 and 10-in. pipe sewer, as stated in our advertising columns. E. A. Jackson, Village Clk.; Engr., R. F. Walker, Troy, O.

YOUNGSTOWN, O.—The council has passed an ordinance for constructing a sewer in Marshall St. J. H. Edwards, Cy. Clk.

MAPLE PARK, ILL.—It is reported that the plans for the new drainage district from the northeast part of the township to Grandy's bridge are about completed.

MILWAUKEE, WIS.—The board of public works constructed 32,221 ft. of brick and 83,615 ft. of pipe sewers last year at a cost of $225,402. The city now has 276 miles of sewers, which have cost $3,932,878.

WATERTOWN, WIS.—Bids are asked by the board of public works until Jan. 18 for constructing 24,651 ft. of 20 to 8-in. pipe sewers. G. O. Viebahn, Cy. Engr.

SAN ANTONIO, TEX.—The contract for constructing 74 miles of sewers, as advertised in Engineering News, was awarded on Jan. 2 to J. B. Hindry, Denver, at $331,209. Samuel M. Gray, Consult. Engr., estimated the cost of the work at $342,886, and recommended against awarding the contract at a bid much less than this estimate. There were 75 bids received, of which 12 were for materials only, 18 for labor only and 45 for both materials and labor. Bids were received for the entire work and also for constructing each of the 10 districts separately. The amount of the lowest 10 district bids was $299,748, or $12,817 higher than the lowest bid for the entire system. Mr. Gray recommended that the work be awarded under one contract. The summary of the 22 formal bids for the construction of the complete system was as follows: Cy. Engr., A. C. Pancoast:

Stratford & Hawkes, Brooklyn, N. Y.	$286,931
George Baer, Kansas City, Mo.	322,833
J. B. Hindry, Denver, Colo.	331,209
R. M. Quigley & Co., St. Louis, Mo.	336,497
Samuel Katz & Co., Omaha, Neb.	346,372
Schryver & Dunn Bros., San Antonio, Tex.	350,317
E. J. Hanlon, Sioux City, Ia.	352,405
W. C. Allen & Co., Indianapolis, Ind.	359,420
W. F. Geedes, D. D. Seerie & Geo. Steinmetz, Denver, Colo.	362,414
T. B. Townsend Const'n Co., Zanesville, O.	363,603
Adam Maurer & Jos. Belger, San Antonio, Tex.	367,158
George A. Tenney, Chattanooga, Tenn.	370,400
Liphardt & Winterhalter, Detroit, Mich.	371,356
Wilson & Strack, Cincinnati, O.	382,259
Rockford Construction Co., Rockford, Ill.	387,174
M. J. Condon, Knoxville, Tenn.	387,457
Campbell, Dennis & Co., Joliet, Ill.	401,032
P. McDonald, Kansas City, Mo.	405,042
J. B. Neeley & Son, Chattanooga, Tenn.	419,706
W. G. Raoul & Geo. Wadley, Atlanta, Ga.	424,631
Fruin Banbrick Const. Co., St. Louis, Mo.	432,784
A. G. Pugh, Columbus, O.	482,644
Average of the 22 bids.	374,711
Engineer's estimate	342,886

LOS ANGELES, CAL.—The city engineer has recommended the construction of 1,000 ft. of 120-in. outlet sewer in Aliso St., estimated to cost $15,000.

GARBAGE DISPOSAL.

BRIDGEPORT, CONN.—The board of health has appointed a committee to get estimates for a site for a crematory, together with the probable cost of collecting the garbage.

SYRACUSE, N. Y.—The city is reported to have contracted with the American Reduction Co., of New York, to dispose of the garbage of the city for 10 years without cost to the city, the city to deliver the garbage at the company's plant. The plant is to be in operation within four months.

CHICAGO, ILL.—The Dixon Sanitary Crematory Co. of Illinois was incorporated last week; capital stock, $500,000; incorporators, Rush H. Field, Chas. F. Bryden and Frank Bonneau.

STREETS AND ROADS.

BOSTON, MASS.—The mayor has approved the street commissioner's plan for laying out Columbus Ave. from Northampton St. to Franklin Park; estimated cost, $926,000.

MARLBORO, MASS.—It is reported that $1,900 has been appropriated for a road roller.

BRIDGEPORT, CONN.—The board of public works has asked for an appropriation of $102,300, an increase of $34,000 over last year, for improving and macadamizing streets. The committee has also petitioned for asphalt paving that is estimated to cost $109,000.

NEW HAVEN, CONN.—The extension of Dwight St., at an estimated cost of about $20,000, is being discussed by the board of public works.

BROOKLYN, N. Y.—A. T. White, Comr. Cy. Wks., reports as follows of work done in 1894: Many miles of streets have been repaved and the city now has 15 miles of asphalt, 32 miles of Belgian blocks, 87 miles of granite blocks and 272 miles of cobblestone. In the year, 35.34 miles of pavement were repaired, and 112 miles have been torn up for street railroads, gas mains and electric light wires.

ELMIRA, N. Y.—The issue of $40,000 in bonds for improving the streets is being discussed

PITTSBURG, PA.—Bids are asked until Jan. 12 for grading, curbing and paving portions of eight streets with asphalt or stone blocks. E. M. Bigelow, Dir. Dept. Pub. Wks.

SHARPSBURG, MD.—Bids are asked by the Antietam Battle-Field Commission until Jan. 17 for macadamizing 7,000 lin. ft. of road 12 ft. wide and 6 ins. thick, and 4,000 lin. ft. 12 ft. wide and 4 ins. thick; also for 50 bbls. cement and other supplies.

WASHINGTON, D. C.—Bids are asked by the district commissioners until Jan. 15 for paving certain alleys with vitrified and asphalt blocks, as stated in our advertising columns.

CINCINNATI, O.—Bids are asked by the board of administration until Jan. 29 for paving and macadamizing two streets.

CLEVELAND, O.—The council has adopted resolutions for a loan of $491,933 for street and sewer improvements.

SANDUSKY, O.—Bids are asked until Feb. 1 for paving Water St. The bids recently received for paving this street with brick were rejected. The work will cost about $30,000. A. W. Miller, Cy. Clk.

HAUGHVILLE, IND.—Bids are asked until Jan. 16 for grading and graveling the sidewalks and portions of three streets. O. S. Wright, Clk.

AURORA, ILL.—The council has passed an ordinance for paving South Fourth St. with brick. J. M. Kennedy, Cy. Clk.

EAST ST. LOUIS, ILL.—The council has voted to advertise for bids for grading and paving St. Louis Ave. from Eighth St. to the Belt Line, a distance of one mile, with brick, estimated to cost $78,189.——Residents of other streets are about to petition the council for the improvement of their streets.

MILWAUKEE, WIS.—The board of public works mittee will soon recommend that several streets be paved with brick. The board of public works paved 64,299 sq. yds. last year with asphalt at a cost of $151,615; for cedar block paving, $188,332 was spent, and for stone paving, $21,480.——It is proposed this year to pave three streets with asphalt; 25 with cedar blocks; three with brick; five with stone, and two with limestone.

ST. PAUL, MINN.—The board of public works has directed the city engineer to prepare estimates for paving Fourth St. from Broadway to Seven Corners with asphalt, and from Minnesota St. to Wabasha St. with granite blocks on concrete foundation.

MISCELLANEOUS CONTRACTS AND SUPPLIES.

PARK BONDS.—Boston, Mass.—The city has sold $1,000,000 of park bonds to N. W. Harris & Co., Farson, Leach & Co., and J. & W. Seligman, at $113,513.

PILES, BRUSH AND STONE.—St. Louis, Mo.—Bids are asked until Jan. 30 for furnishing piles, brush and stone during 1895. Maj. Chas. J. Allen, U. S. Engr. Office.

TELEPHONE FRANCHISE.—Waupaca, Wis.—The Badger Telephone Co. has been granted a franchise to erect and maintain a telephone system in this city. A. T. Curtis, Cy. Clk.

FENDER WORK.—Tompkinsville, N. Y.—Bids are asked until Jan. 17 for erecting fender work to protect east face of south wall at lighthouse depot. Lieut.-Col. Peter C. Hains, U. S. Lighthouse Engr.

TELEGRAPH LINE.—Springfield, Ill.—The Postal Telegraph Cable Co. is reported as rewiring this city, and about to put in another wire between this city and Chicago for use during the session of the general assembly.

TELEPHONE FRANCHISE.—Butler, Pa.—The town council has granted the right of way through Saxonburg streets to the People's Telephone Co., and the line will now be pushed to completion within a short time, according to reports.

CAR SHOPS, ETC.—Benton Harbor, Mich.—It is reported that the Cleveland, Cincinnati, Chicago & St. Louis Ry. Co. will build a track through the center of this city and will establish smelting works, car shops and other improvements, which will employ 500 men.

STATIONARY ENGINE.—National Soldiers' Home, Va.—Bids are asked until Jan. 15 for furnishing and placing one stationary side-crank engine of the Cleveland & Hardwick pattern or equal thereto. Wm. Thompson, Treas., National Soldiers' Home, Elisabeth City county, Va.

CHEMICAL ENGINE.—Buffalo, N. Y.—The following bids for a chemical engine were opened by the fire commissioners Jan. 7: Hayward & Co., New York, $1,450; Charles T. Holloway, Baltimore, Md., $1,500; Kendall Mfg. Co., Buffalo, $1,695. Hayward & Co. did not comply with specifications, and it is stated that the board will recommend that contract be awarded to Mr. Holloway.

RAILWAY SHOPS.—Knoxville, Tenn.—C. M. Bolton, Washington, D. C., Ch. Engr. Southern Ry., is reported as stating that work will commence at once on the completion of the shop which was commenced in this city by the old East Tennessee, Virginia & Georgia R. R. Co. The shop will give employment to 2,500 men and will cost when completed $475,000, according to the reports.

TELEPHONE PLANTS.—Zanesville, O.—The "News" states that agents are securing subscribers for a new telephone service, at $18 per year for residences and $24 for business houses, and it is expected

that 600 subscribers will be secured and a new plant put in at once; also that the contract for a new telephone plant at Newark, O., with 200 subscribers, was to have been awarded last week. Gen. Man., Al. Brennan, Zanesville.

TELEPHONE FRANCHISE.—St. Paul, Minn.—The United Electric Corporation, of Minneapolis, has petitioned for a franchise to construct and operate a telephone system in this city. It promises telephones at a maximum rate of $4 per month, irrespective of distance from the central office, for business houses and $3 for private residences. The present rates are $6 and $5 respectively, with $2 and $1 per month added for each mile beyond a certain distance from the central office. Sam Grant, son of Donald Grant, of Faribault, Minn., is president of the company.

WIRE FENCING, ETC.—Sharpsburg, Md.—Bids are asked until Jan. 17 by the Antietam Battle-Field Commission for furnishing and delivering 21,000 lin. ft. Jones's wire locked fencing, 10 wire, 6 stays per rod, with 1,300 yellow locust posts, 4 ins. square and 8 ft. long; erected fence; macadamizing 7,000 lin. ft. of road, 12 ft. wide, 4 ins. thick; macadamizing 4,000 lin. ft. of road, 12 ft. wide, 4 ins. thick; 18 single farm gates; 6 double farm gates; 48 pieces dressed chestnut lumber, 12 ins. square, 10 ft. long;10 bbls. coal tar; 50 bbls. hydraulic cement; 2,000 stakes, 2 ins. square, 3 ft. long; 50 pieces 12-in. vitrified pipe, 2 ft. long; erecting 50 cast iron tablets, and setting same in cement.

RIVER IMPROVEMENTS.—Washington, D. C.—Secretary Lamont has sent to the House reports of officers of the Engineer Corps on preliminary surveys and the estimated cost for the following river improvements: Chelsea River, Mass., from Grand Junction bridge to Boston & Maine R. R. bridge, dredging, $65,000; Delaware River, between Trenton and Burlington, N. J., survey, $1,000; West bank of the Mississippi from Flint Creek to the mouth of the Iowa River, building an artificial bank to prevent overflow, $305,000; Forked Deer River, from Dyersburg, Tenn., to its junction with the Obion River, and from there to the Mississippi, so as to make it navigable all the year, $400,000.

TELEPHONE LINE.—Fargo, N. Dak.—A press report states that Capt. C. P. Wainman, of Minneapolis, has returned home after inspecting the telephone plant in Fargo,, and he states that the company is going to build a line from Grand Forks to Fargo in the spring, and may extend the Fargo and Casselton line on through Wheatland and Buffalo to Tower City, and will probably connect Mayville, via Hillsboro, with Fargo. It is decided, he says, that we extend our line to Grand Forks in the spring. We have a long distance line to St. Cloud, and will extend it to Little Falls, and in time to Fargo. Our line south from Minneapolis and St. Paul will connect us with Chicago, so we will have a long distance phone clear through, I hope, next year.

be used by the Baltimore & Ohio to draw traffic through its tunnel prove a success, the Pennsylvania will also use electric power and do away with the smoke and coal-gas nuisance. The new tunnel would probably be used for passenger travel and the old one for freight trains.

CONTRACT PRICES.

WATER-TUBE BOILERS.—St. Louis, Ill.—The contract for furnishing eight horizontal water-tube boilers, with valves, etc., and placing them in boiler house of high-service pumping station No. 1 at Bissell's Point, has been awarded to the Leary Boiler Co., of Oil City, Pa., at $34,000. It is stated that the estimated cost was $45,000. The bids were as follows:

Abendroth & Root, Mfg. Co., 28 Cliff St., N. Y.	$44,500
Leary Water-Tube Boiler Co., Oil City, Pa.	34,000
Nat. Water-Tube Boiler Co., New Brunsw'k, N.J.	44,975
Babcock & Wilcox Co., New York	71,765
John O'Brien Boiler Works Co., St. Louis, Mo.	37,997
Heine Safety Boiler Co., St. Louis, Mo.	46,467
The Sterling Co., Chicago, Ill.	37,500

GUN CARRIAGES.—Washington, D. C.—The following bids were received at the War Department for supplying nine or more disappearing gun carriages for the 10-in. coast defense rifles: Pond Machine Tool Co., New York, $14,273 each; first delivery in 10 months, second in 13 months, third in 16 months, and one every 2 months thereafter. Philadelphia Engineering Works, $15,300 each; first one in 5 months, second in 7 months, and then 1 every month. Bethlehem Iron Co., Bethlehem, Pa., $15,000, 1 in 4 months, 2 in 6 months, and then 1 per month thereafter; same carriages for $15,000 each; first in 6 months, second in 8 months, and remainder 1 every 6 weeks thereafter. Farrel Foundry & Machine Co., Ansonia, Conn., $15,745; 1 in 9 months, and 1 per month afterward. Robert Poole & Son Co., Baltimore, $15,996; 1 in 4 months, 2 in 6, and then 1 per month if 5 or more are ordered. William Cramp & Sons, Philadelphia, $16,000; 1 in 4 months, and then 1 per month. Southwark Foundry & Machine Co., Philadelphia, $16,250; 1 in 9 months, 2 in 12, and 1 every 6 weeks. Weimer Machine Works, Lebanon, Pa., $16,347; 1 in 6 months, and 1 every 2 months. Builders' Iron Foundry, Providence, R. I., $16,500; 1 in 6 months, and 1 every 2 months. William Todd & Co., Youngstown, O., $17,900; 1 in 5 months, next 4 at the rate of 1 in each succeeding 1½ months, the remainder 1 per month thereafter. Morgan Engineering Co., Alliance, O., $19,278; 1 in 4 months, then 1 every 6 weeks thereafter; if cast iron in place of lead be used in counterweights, the carriages will be furnished for $16,790 each.

SEWERS.—Fortress Monroe, Va.—Maj. Chas. E. L. B. Davis, U. S. Engineer Office, Washington, D. C., informs us that the following bids were received Dec. 29 for constructing a sewerage system at Fort Monroe, as advertised in Engineering News:

Bids Received for Constructing Sewer System at Fort Monroe, Va.

Quantities.		John Jacobi, Wilmington, Del.	Jos. Jenkins, Wilmington, Del.	H. Davin, Roanoke, Va.	Crook, Horner & Co., Baltimore, Md.	Isaac T. Brown, 11 Pine St., New York.	Corcoran & Connell, 134 W. Water St., Pittsburg, Pa.	T. L. Rosser, Jr., Bank Commerce Bldg., Minneapolis, Minn.	Owen Patterson, Baltimore, Md.	Hankins, Mosby & Kelley, Richmond, Va.	T. Brennan & Co., Baltimore, Md.
6-in.	5,000 lin. ft., at	$0.60	$0.53	$1.10	$0.25	$0.65	$0.37	$0.37	$0.65	$0.33	$0.87
8-in.	8,800 " " "	.84	.59	1.17	.73	.85	.86	.46	.80	.43	.94
10-in.	250 " " "	1.08	.64	1.25	1.05	1.25	1.01	.83	1.00	.63	1.15
12-in.	270 " " "	1.20	.70	1.32	1.25	1.50	1.26	.95	1.25	.93	1.25
14-in. vit. outfall	1,300 " " "	1.50	.85	1.35	.68	1.50	.90	.80	1.85	.71	1.30
Cross ditch,	1,110 " " "	7.44	50.00	19.95	12.50	20.00	10.00	4.40	5.00	10.00	6.00
Manholes	45 "	50.00	50.00	140.00	85.54	75.00	58.00	35.00	85.00	43.00	74.50
Flush tanks	13 "	75.00	100.00	260.00	120.54	100.00	124.00	60.00	110.00	1.65	134.00
Reservoir		10,800	12,500	11,419	14,798	9,981	21,870	10,345	13,797	11,500	12,083
Pumping station		7,200	8,500	11,700	6,954	8,300	6,900	7,530	8,200	7,000	8,200
Force main	590 lin. ft., at	1.50	.95	1.75	.96	5.00	1.10	1.00	1.25	2.00	1.35
Iron outfall	390 " " "	9.84	11.25	21.00	12.68	20.00	12.30	9.75	27.50	17.00	47.00
Concrete	100 cu. yds., "	7.00	10.00	8.50	8.25	8.00	8.00	7.00	8.00	13.00	9.26
Brick masonry,	100 " " "	14.00	15.00	11.00	13.30	8.00	11.40	8.50	12.50	13.00	10.00
Total		$42,597	$47,245	$65,051	$45,790	$51,599	$53,136	$34,483	$55,578	$41,205	$62,715

RAILS AND LOCOMOTIVE.—Addison, Miss.—Thompson & Hinton are reported about to contract for three miles of 30-lb. iron rails and a 10-ton logging engine.

CANAL.—Baltimore, Md.—It is stated that capital is being raised in this city to widen and deepen the old Dismal Swamp Canal, a waterway that antedates railroading in the United States, and numbered George Washington and Patrick Henry among its promoters. The canal proper is 22 miles long, but only from 3 to 4 ft. deep. It is proposed to give the canal a width of 60 ft. and a uniform depth of 10 ft. The existing five small locks will be removed, and a lock at the inlet and outlet of the canal, 250 × 40 ft. each, will be substituted. The canal has been of little use because of the deeper drafts of the neighboring Albemarle & Chesapeake Canal. The Dismal Swamp Canal connects the Paulico and Albermarle Sounds, in North Carolina, with the Chesapeake Bay, and is tributary to Baltimore. It is thought that a large portion of the trade in Eastern North Carolina dependent upon roundabout railways will seek the more direct and cheaper transportation by canal. With a draft of 8½ ft. in the canal a lumber barge could carry 350,000 ft. of timber. The canal avoids the well-known dangers of Capt Hatteras.

TUNNEL.—Baltimore, Md.—A press report from this city states as follows: The Pennsylvania R. R. Co. is considering plans for the construction of another tunnel alongside the one now in use in this city. The present tunnel, which runs under the northeastern and northwestern sections of the city, has only two tracks. The western section of the tunnel is also used by the Western Maryland R. R., and the travel through it has so largely increased that trains are often delayed. This tunnel is over a mile in length and has two openings. It is partly ventilated by electric fans, but its construction will hardly admit of the improvements to be found in the new Baltimore & Ohio tunnel, which will be lighted by electricity. When the Pennsylvania builds its new tunnel it will be lighted in the same improved manner, and should the electric locomotives to

CAST IRON PIPE.—Providence, R. I.—The contract for 11½ tons of 4-in., 180 tons of 6-in., 230 tons of 8-in. and 45 tons of 12-in. pipe has been awarded to the Warren Foundry & Machine Co., at $20.80 per ton of 2,240 lbs.

DREDGING.—New York, N. Y.—The contract for 200,000 cu. yds. of mud dredging has been awarded to John H. Fenner, at 14½ cts. per cu yd., this being the lowest bid.

LEAD.—Detroit, Mich.—The water commissioners have contracted with the Detroit Lead Pipe & Sheet Lead Wks. for 80 tons of lead, at 2.98 cts. per lb. The price paid last year is reported to have been 3⅛ cts. per lb.

STREET LIGHTING.—Brooklyn, N. Y.—The following bids were received for lighting the streets and public buildings of the city for the current year: Edison Electric Illuminating Co., 40 cts. per night for each arc light of 1,200 c. p. and 20 cts. for those of 600 c. p.; for incandescent lights of 16 c. p., eight-tenths of a cent per hour, meter measurement. Citizens' Electric Illuminating Co. and the Municipal Electric Light Co. each bid 40 cts. for arc lights of 1,200 c. p.; incandescent lights, 16 c. p., 20 cts. per 1,000 volts, meter measure. The Nassau, People's, Brooklyn, Metropolitan and Williamsburg Gas companies each bid $18.75 per year per lamp for the open-bottom bracket and $18.25 for the closed-bottom bracket, and for lighting public buildings, $1 per 1,000 cu. ft. Citizens' Gas Co. bid for the district comprised in wards 3, 6, 10 and 12 at the same prices as the others; in ward 26, $23.75 and $23.25, respectively.

WROUGHT IRON PIPE.—Woodland, Cal.—The contract for 8,000 ft. of 4-in. wrought iron water pipe has been awarded to M. Diggs, the bids being as follows: Crane & Co., 21 cts. per lin. ft., San Francisco delivery; Christian Froelich, 20 cts., Woodland delivery; John Market, 30 cts., Woodland delivery; M. Diggs, Woodland delivery, 21¼ cts.; Shaw, Ingram, Balcheider & Co., Woodland delivery, 23 cts.; Dunham, Carrigan, Hayden Co., Woodland delivery, 21.24 cts.; George Dow, Woodland delivery, 28½ cts.

PUMPING ENGINES.—Madison, Ind.—Bids for a 2,000,000-gallon pumping engine were submitted by the Laidlaw-Dunn-Gordon Co., Cincinnati, and Henry R. Worthington, New York, as follows, according to local papers: One compound engine, $10,000 and $6,250, respectively; with condenser, $11,200 and $7,175.

CAST IRON PIPE.—Detroit, Mich.—The water commissioners have awarded a contract for 6,044 tons of water pipe to the Michigan-Peninsular Car Co., at $18 per ton. The company is reported as stating that the $3,500 margin of profit in the contract will be used in building a plant for the manufacture of the 42-in pipe included in the 6,044 tons, but that this contract will permit the employment of a large number of men who would otherwise be thrown out of employment this winter.

SEWERS.—Mount Vernon, N. Y.—The following bids were received for constructing the 12th and 13th Ave. and 3d St. drain:

Quantities.	C. Howard, Mt. Vernon.	E. E. Henriques, Mt. Vernon.	W. C. Weiss & Co., Mt. Vernon.	D. Murray, Portchester, N. Y.	J. R. Byron, Mt. Vernon.	Cortwright & Kenton, Mt. Vernon.
*Receiv'g basins, 14	115.00	84.00	150.00	150.00	117.00	96.00
15-in., 585 ft.	1.00	.99	1.48	1.20	1.10	.75
18-in., 832 ft.	1.17	1.05	1.90	1.40	1.31	.95
20-in., 270 ft.	1.40	1.29	2.10	1.50	1.51	1.12
24-in., 255 ft.	1.75	2.81	2.40	1.75	2.30	1.55
Rock excav., 100 cu. yds.	2.35	1.25	4.00	3.00	2.60	2.25
Manholes, 11	44.00	37.00	65.00	40.00	38.00	46.00
Plank, 1M. ft.	18.00	2.00	26.00	.50	22.00	5.00

* Receiving basins and 10-in. pipes connecting with manholes.

BRICK PAVING.—Lima, O.—R. H. Gamble, Cy. Engr., has sent us a statement of the bids received Dec. 23 for paving the public square with brick. The work was advertised last summer and the bids published in our issue of July 12. All bids received last month were separate on material and labor, but in the following table the separate prices are shown only in the lowest two bids. The contract has not yet been awarded, but the paving committee has recommended the award to Coleman & Hallwood, of Columbus, O., for the material, at their bid of 56 cts. per sq. yd. on Zanesville Hallwood blocks, with 8 ins. crushed stone foundation and Murphy grout filling; and that the labor be awarded to Currie & Conn, of Detroit, Mich., at their bid of 27 cts. per sq. yd., making a total of 83 cts. per sq yd., exclusive of curbing. If the report of committee is not adopted, or the parties fail to qualify, the next lowest bid is by T. B. Empie, of Fort Wayne, Ind., on the Massillon block, with 8 ins. stone foundation and Murphy grout filling, at $1.38 per sq. yd. Any other combination of separate bids would make a higher aggregate than Mr. Empie's bid of $1.38. These bids are much lower than those received several months ago for this work. In the table (1) is the price with concrete foundation and (2) the price for crushed stone foundation:

Wm. F. Tracy, Lafayette, Ind.

	Filling—Sand. 1. $	Sand. 2. $	Tar. 1. $	Tar. 2. $	Murphy. 1. $	Murphy. 2. $	Cement. 1. $	Cement. 2. $
Canton stand. brk.	1.47	1.32	1.67	1.52	1.65	1.50	...	...
" repres'd "	1.56	1.41	1.75	1.60	1.73	1.58	...	...
" block	1.56	1.41	1.75	1.60	1.73	1.58	...	...
Mack block	1.54	1.39	1.54	1.39	1.74	1.59	...	...
" repressed brk.	1.81	1.65	1.94	1.78	1.92	1.76	...	...
" standard "	1.49	1.34	1.72	1.57	1.70	1.55	...	...
Malvern "	1.54	1.39	1.74	1.59	1.72	1.57	...	...
Malv. blue gran. blk.	1.63	1.48	1.82	1.67	1.80	1.65	...	...
Massillon block	1.78	1.62	1.91	1.75	1.89	1.73	...	...
" rprsd. brk.	1.77	1.61	1.90	1.74	1.88	1.72	...	...
" stand. "	1.48	1.33	1.68	1.53	1.66	1.51	...	...

Coleman & Hallwood, Columbus, O.

Zan'sv'le Hall'd blk.:								
Material	1.01	.49	1.08	.56	1.08	.56*	1.05	...
Labor	.59	.91	.66	.98	.66	.98	.63	...
Nels'n v'le Hall'd blk.:								
Material	1.54	.53	1.68	.60	1.68	.60	1.62	...
Labor	1.54	.81	1.68	.88	1.68	.86	1.62	...

T. B. Empie, Fort Wayne, Ind.

Concrete foundation—								
Canton stand. brk.	1.38	1.22	1.48	1.32	1.50	1.34	1.48	1.32
" repres'd "	1.42	1.26	1.52	1.36	1.54	1.38	1.52	1.32
" block	1.43	1.27	1.53	1.37	1.55	1.39	1.53	1.37
Halloway block	1.51	1.35	1.61	1.45	1.63	1.47	1.61	1.45
" rprsd. brk.	1.53	1.37	1.63	1.47	1.65	1.49	1.63	1.47
" stand. "	1.45	1.29	1.55	1.39	1.57	1.41	1.55	1.39
Massillon block	1.42	1.26	1.52	1.36	1.54	1.38	1.52	1.36
" rprsd. brk.	1.41	1.25	1.51	1.35	1.53	1.37	1.51	1.35
" stand. "	1.37	1.21	1.47	1.31	1.49	1.33	1.47	1.31

M. A. Cain, Dayton, O.

Malv. blue gran. blk.	1.70	1.60	1.70	1.60	1.72	1.62	1.70	1.60
Massillon block	1.62	1.52	1.66	1.56	1.68	1.58	1.66	1.56
Athens Hallw'd blk.	1.61	1.51	1.68	1.58	1.68	1.58	1.65	1.55
Nisnvle. "	1.64	1.54	1.69	1.59	1.69	1.59	1.66	1.56
Athens block	1.60	1.50	1.67	1.57	1.67	1.57	1.65	1.55
Nelsonville block	1.62	1.52	1.68	1.58	1.68	1.58	1.65	1.55

Porter & Hadley, Tipton, Ind.

Malv. blue gran. blk.	1.56	1.36	1.66	1.46	1.68	1.48	...	...
" repressed brk.	1.54	1.34	1.64	1.44	1.66	1.46	...	...
" standard "	1.52	1.32	1.62	1.42	1.64	1.44	...	...

Currie & Conn, Detroit, Mich.

Canton stand. brk.:								
Material	1.07	.97	1.16	1.06	1.18	1.08	1.13	1.03
Labor	.27	.27	.27	.27	.27	.27*	.27	.27
Canton block:								
Material	1.13	1.03	1.22	1.12	1.24	1.14	1.19	1.09
Labor	.27	.27	.27	.27	.27	.27*	.27	.27
Metropolitan block:								
Material	1.11	1.01	1.20	1.10	1.22	1.12	1.17	1.07
Labor	.27	.27	.27	.27	.27	.27*	.27	.27
Royal block:								
Material	1.11	1.01	1.20	1.10	1.22	1.12	1.17	1.07
Labor	.27	.27	.27	.27	.27	.27*	.27	.27
Imperial block (small):								
Material	1.15	1.05	1.24	1.14	1.26	1.16	1.21	1.11
Labor	.27	.27	.27	.27	.27	.27*	.27	.27

*Recommended for acceptance.

STEEL RAILS.—Philadelphia, Pa.—The Pennsylvania R. R. Co. is reported to have made its contract for steel rails this year at $22 per ton. The "Press" states as follows: This is the lowest price steel rails have ever been sold at in this section of the United States, although it is said that there was once a special sale which was slightly below the market price. The contract calls for 30,000 tons, divided as follows: 8,000 tons each to the Cambria, the Pennsylvania and the Carnegie Steel companies, and 6,000 to the Scranton Steel Co. In 1890 the market price of steel rails was $32 a ton; in 1891, $30; in 1892, $30; in 1893, $28; in 1894, $24; and in 1895, $22.

METAL MARKET PRICES.

LEAD.—New York: 3.05 to 3.1 cts. Chicago: 2.85 to 2.9 cts. St. Louis, 2.8 cts.

NAILS.—Pittsburg: 90 to 95 cts. for wire, and 80 cts. for cut at mill in carload lots.

BARBED WIRE.—Pittsburg: galvanized, $1.90; plain, $1.25, for carloads at mill.

FOUNDRY AND PIG IRON.—New York: $10.00 to $12.50. Pittsburg: $10.50 to $11.25. Chicago: $9.50 to $10.50.

TRACK MATERIAL.—New York: angle bars, 1.25 to 1.4 cts.; spikes, 1.45 to 1.6 cts.; track bolts, 2 to 2.1 cts. with square, and 2.15 to 2.3 cts. with hexagon nuts. Chicago: angle bars, 1.3 to 1.35 cts.; spikes, 1.6 to 1.7 cts.; track bolts, 1.9 to 2 cts., with hexagon nuts.

RAILS.—New York: $22 at eastern mills and $22.75 at tidewater; old rails, $10.00 for iron, and $9.00 for steel; steel rails fit for relaying, $14.00; light rails, $20 to $22; girder rails, $24. Pittsburg: $22 for standard sections of 45 lbs. and over; old rails, $12 for iron and $9 to $11 for steel. Chicago. $23 for standard sections; old rails, $10.50 to $10.75 for iron, and $6 to $9 for steel.

STRUCTURAL MATERIAL.—New York: beams, 1.3 to 1.5 cts.; channels, 1.35 to 1.5 cts.; angles, 1.2 to 1.35 cts.; tees, 1.4 to 1.6 cts.; universal mill plates, 1.2 to 1.35 cts.; steel plates, 1.25 to 1.4 cts. for tank, 1.4 to 1.45 cts. for shell, 1.5 to 1.65 cts. for flange, 1.75 to 2 cts. for ordinary firebox. 2 to 2.25 cts. for locomotive firebox. Pittsburg: beams, 1.25 to 1.35 cts.; channels, 1.25 to 1.35 cts.; angles, 1.1 to 1.2 cts.; tees, 1.35 to 1.4 cts.; universal mill plates, 1.1 to 1.2 cts.; steel plates, 1.1 to 1.25 cts. for tank, 1.3 to 1.35 cts. for shell, 1.35 to 1.4 cts. for flange, 2.5 to 3.75 for ordinary firebox, and 3.35 to 3.5 cts. for locomotive firebox. Chicago: beams, 1.45 to 1.5 cts.; channels, 1.45 to 1.5 cts.; angles, 1.35 to 1.4 cts.; tees, 1.65 cts.; universal plates, 1.35 to 1.4 cts.; steel plates, 1.35 to 1.4 cts. for tank, 1.5 to 2 cts. for flange, 2 to 4.5 cts. for firebox.

IRON AND STEEL PRICES.—The New York "Journal of Commerce" says that pig iron dealings are still chiefly of routine type, about the only exceptions being in occasional instances when some inducement in the form of a special price may be made. Upon the whole the tone of the market is rather weak. Old material shows little change in price and is selling in a moderate way only. The situation in manufactured iron and steel is practically unchanged. A very fair business in beams, girders, plates, etc., goes through, and some improvement is noted in sales of bars, rods, etc., but no change for the better in prices takes place. Railway patronage is poor, although probably somewhat better than it was just prior to the holidays, but the orders for rails have not involved any considerable quantities since the Pennsylvania contract was placed.

INDUSTRIAL NOTES.

A WIRE NAIL FACTORY, employing about 300 men, is to be established at Elwood, Ind.

THE SAGAMORE MILL, at Fall River, Mass., was partly destroyed by fire on Jan. 1, involving a loss of $40,000.

THE DEANE STEAM PUMP CO., of Holyoke, Mass., has shipped a pump to the water-works of Lewiston, Me.

J. T. SHIELDS & CO. will build a railway switch about 300 ft. long into their new limestone quarries, at Elwood City, Pa.

THE JUNCTION IRON & STEEL CO., of Mingo Junction, O., has placed contracts for additional rolling mill and other machinery.

THE COLUMBIA LIBERTY IRON WORKS, of Edinburg, Va., have been sold to a Philadelphia company represented by Alexander Balfour.

AN ASPHALT COMPANY has been organized at St. Jo, Tex., to develop neighboring asphaltum beds. Pres., R. F. Sampson; Treas., J. D. Evans.

A COTTON MILL on a large scale at St. Louis, Mo., is proposed by Jerome Hill and others, and the project is favorably considered by local cotton dealers.

THE LENOIR CAR CO., of Lenoir, Tenn., has orders for 250 hopper-bottom coal cars for the Southern Ry. and 100 freight cars for the Knoxville & Ohio Ry.

THE VAN ALEN NAIL MILL at Northumberland, Pa., was burned Dec. 29, and 40,000 kegs of nails are said to have been destroyed. The loss is put at $100,000.

THE COLORADO PAVING CO., of Houston, Tex., will purchase machinery and put in a plant involving the expenditure of $35,000 for its asphalt paving contracts.

THE UNION WATER METER CO., of Worcester, Mass., will establish a new plant at Millbury, and plans have been prepared for a two-story building 135 × 70 ft.

THE WESTINGHOUSE ELECTRIC & MFG. CO., of Pittsburg, Pa., has commenced the shipment of the electric plant for developing the water power of Niagara Falls.

HOUGHTON & RICHARDS, 150 Oliver St., Boston, Mass., have the agency for the steel tires for locomotive and car wheels manufactured by the English firm of Cammel & Co.

THE CAMPBELL & ZELL CO., of Baltimore, Md., manufacturing the Zell water tube boilers, etc., will build a new brick machine shop 50 × 200 ft. and put in tools and machinery.

THE UNION CAR CO., of Depew, N. Y., is building 30 flat cars for the Toronto, Hamilton & Buffalo Ry., 20 flat cars for the Buffalo & Susquehanna R. R., and two snow plows.

THE ARGO MILLS CO., of Gloucester, N. J., will reopen the mills of the old Washington Mfg. Co., and put in new machinery. A power house is to be erected for a new Wetherill engine.

THE WHEELER STERLING STEEL CO., of Pittsburg, Pa., has a large order for its 13-in. projectiles for the government. A new rolling mill plant is to be erected at a cost of $150,000.

THE SARGENT CO., of Chicago, Ill., will start up its open-hearth steel plant, which has been out of operation since June, 1893, only the foundry and crucible steel plant being now in operation.

THE JOHNSON CO., of Lorain, O., is having five barges of 200 tons capacity built to carry the company's product to tidewater ports by way of the lakes and the canals. One of the boats is a steam barge.

THE YOUNGSTOWN IRON & STEEL ROOFING CO., of Youngstown, O., has orders for about 150 tons of roofing and 1,000 squares of curved corrugated iron. The works are being run at their full capacity.

THE MEMPHIS CAR & FOUNDRY CO. of Memphis, Tenn., is rebuilding and repairing freight cars for the Kansas City, Fort Scott & Memphis R. R. The works are new and cover about 50 acres of land.

THE DODGE COAL STORAGE CO., of Philadelphia, Pa., is at work on a coal handling and storing plant at Port Richmond, for the Philadelphia & Reading R. R. It will operate six coal piles, aggregating 180,000 tons.

BOILER WORKS are to be established at Athens, Pa., by Charles and Erastus Kellogg, the city, through the Board of Trade, agreeing to furnish the buildings, which will include a machine shop 40 × 100 ft., and boiler shop 40 × 60 ft.

STEEL RAILS to the amount of 30,000 tons have been ordered by the Pennsylvania R. R., the order being divided between the Pennsylvania Steel Co., Cambria Iron Co., Scranton Steel Co. and the Edgar Thomson Steel Works.

H. W. HARTMAN, OF THE PITTSBURG CO., at Ellwood City, Pa., is making arrangements with the Pittsburg & Western Ry. Co., for the building of a side track, about 1,500 ft. long, to enable him to open up a large sandstone quarry, at Ellwood City.

THE BALDWIN LOCOMOTIVE WORKS, of Philadelphia, Pa., have an order for six fast passenger engines for the Atlantic Coast Line. They have 6-ft. driving wheels, weigh 121,000 lbs. and are said to be designed for trains of six to ten sleeping cars.

THE WESTERN PAINT CO., of Cincinnati, O., has put up new works, including a four-story main building 40 × 100 ft., stock house, warehouse and nine oil tanks of 60,000 gallons capacity. New machinery for grinding and mixing paint has been put in.

THE CLEAR CREEK GOLD MINING & WATER POWER CO., of Denver, Colo., proposes to utilize the water of Clear Creek for generating electricity for mills, etc., and transmitting power to Denver and Central City. The creek has a fall of 100 ft. to the mile.

THE FERTILIZER WORKS of Griffith & Boyd, at Canton, Md., were burned Jan. 6, involving a loss of $200,000. The same fire also burned the acid works of G. H. & T. C. Davidson, and damaged the buildings and plant of the Standard Oil Co. and the Baker-Whitney Coal Co.

THE ENSIGN MFG. CO., of Huntington, W. Va., has an order from the Chesapeake & Ohio Ry. for 100 convertible stock and freight cars, designed by W. S. Morris, Superintendent of Motive Power. They will have air-brakes, Janney couplers, Butler draft rigging and National hollow brakebeams.

THE UNION STEEL CO., of Alexandria, Ind., has recently been incorporated with a capital of $500,000 and is said to intend establishing steel works on a large scale. It is a consolidation of the Depauw Steel Co. and the New Albany Rail Mill Co., part of whose plant was removed to Alexandria in 1893.

THE STOW MFG. CO., of Binghamton, N. Y., writes us that it has designed a number of new appliances for use with the Stow flexible shaft, and that it has recently added a foundry department to its plant. It states that for the past few months its business has shown a steady, healthy growth and that it expects to do a very satisfactory business in 1895.

THE MICHIGAN-PENINSULAR CAR CO., of Detroit, Mich., has a contract for 6,044 tons of cast iron pipe for the Detroit water-works. The work will be done in the foundry department but a new plant will have to be put in for the manufacture of the 42-in. size, so that it is said the company will make but little profit, but will be able to keep its men at work during the winter.

FRASER & CHAIMERS, of Chicago, Ill., state that the Brown horshoe furnace, manufactured and sold by them to the Consolidated Kansas City Smelting & Refining Co., of Argentine, Kan., is now erected and in constant operation, roasting copper matte to a sulphate at one operation. Two of these furnaces are in operation at Leadville, Colo., one in the works of the Union Smelting Co., the other at the Arkansas Valley Works.

THE RYAN & McDONALD MFG. CO., of Baltimore, Md., states that it has just filled an order from the Monterey Mineral Ry. & Terminal Co., of Mexico, for 50 eight-wheel ore cars, gondola type, 40,000 lbs. capacity, 3-ft. gage, fitted with channel ridged trucks and equipped with Westinghouse air-brakes, National hollow brakebeams, etc. These cars are shipped by steamship from Baltimore to Tampico, Mexico.

THE ANDERSON FOUNDRY & MACHINE WORKS, of Anderson, Ind., are manufacturing tinning machinery for the following works: Great Western Tin Plate Co., Joliet, Ill.; Monongahela Tin Plate Works, Pittsburg, Pa.; Ellwood Tin Plate Works, Ellwood City, Pa.; Cincinnati Corrugating Co., Piqua, O.; Irondale Steel & Iron Co., Middletown, Ind., and the National Tin Plate Works, Anderson, Ind.

THE SHOENBERGER STEEL CO., of Pittsburg, Pa., recently incorporated with a capital stock of $1,800,000, acquires all the plant and property of Shoenberger & Co., one of the oldest steel manufacturing firms of Pittsburg. It includes the two Juniata blast furnaces, with an annual capacity of 102,000 tons of iron, and the extensive plant at 1st and Etna Sts., which have an annual capacity of 100,000 tons of firebox and other plates, horseshoe blooms and billets, etc.

PATTON & GIBSON, 531 Wood St., Pittsburg, Pa., have the contract for the entire construction of plant for opening up extensive mines for the Connessing Coal Co., on the line of the Pittsburg & Western Ry., at Pine Hill, about 40 miles west of Pittsburg. It includes tipples, incline, inside timber work, driving of the main and cross-headings and the entire equipment complete and ready to run coal. They have placed the order for the construction of the mining cars with the Phillips Mine & Supply Co., of Pittsburg, and expect to complete their contract and turn over the plant complete to the Connessing people by Jan. 20. This plant is to be a model for the thin vein mines in this neighborhood. It is timbered inside with Michigan pine timber. All uprights, sills and caps are 12 × 12 ins., the bents are set 6 ft. c. to c., and the sides and top are lagged with 3-in. pine; 35-lb. steel rails are used inside and outside, laid on white oak ties.

NEW COMPANIES.—Homan Mfg. Co., Jersey City, N. J.; $100,000, commencing with $1,000; fenders for street cars; Chas. L. Steele, Frank H. Homan and Frank C. Johnson, of Brooklyn, N. Y.

Elevator Iron Co., Tyrone, Pa.; $10,000; Treas., H. L. Shotly.

Hannibal Ferry Co., East Hannibal, Mo.; $9,000; Daniel Hofner and Geo. F. Maris.

W. H. Hill Lime & Cement Co., East St. Louis, Ill.; $25,000; W. H. Hill and H. M. Hill.

J. L. S. Hunt Co., San Antonio, Tex.; $100,000; J. L. S. Hunt, W. H. Weir and J. A. Gray.

Carnegie Bridge Co., Chicago, Ill.; $400,000; John C. Fleming, W. H. Eaton and P. W. O'Brien.

Combination Power Co., Chicago, Ill.; $400,000; John E. Anderson, Isaac T. Dyer and L. J. Blades.

Buckeye Gas Co., Circleville, O.; $300,000; E. B. Bradley, Nelson L. Williams and H. E. Varney.

Pioneer Rail Renewing Co., Chicago, Ill.; $50,000; George L. Clagg, D. C. Tanner and W. C. Jones.

American Asphalt Co., Columbus, O.; $100,000; G. W. Sinks, W. E. Guerin and Henry S. Hallwood.

Chicago Coke & Fuel Co., Chicago, Ill.; $40,000; Thomas D. Jones, H. H. Martin and A. C. Wilson.

Dixon Sanitary Crematory Co., Chicago, Ill.; $500,000; Rush H. Field, Chas. F. Bryden and Frank Bonneau.

Morgan Signal Co., Ypsilanti, Mich.; $150,000; W. H. Guerin, Benjamin A. Morgan and E. D. Holmes.

Crum-Lynne Iron & Steel Co., Philadelphia, Pa.; $25,000; Treas., J. Jones Hudson, 216 South Third St.

Fulton Pipe Line Service Co., Fulton, Ill.; $150,000; Frank B. Draper, E. W. Adkinson and F. F. Douglass.

Economical Refrigerating Co., Chicago, Ill.; $500,000; Eliel L. Sharpneck, John R. Knox and George P. Smith.

Ash Oil & Gas Co., West Union, W. Va.; $2,000,000, commencing with $20,000; Henry Ash and J. G. Williams.

Beamer Perfect Steel Fence Co., Danville, Ill.; $50,000; Frederick M. Beamer, L. O. Thistle and Wm. Thistle.

Empire State Pulley & Press Co., Fulton, N. Y.; $20,000; Francis Stiles, J. E. Sheridan and George Ehrhart.

Wyandotte Office Building Co., Columbus, O.; $300,000; John G. Deshler, T. B. Galloway and George W. Sinks.

Kisinger-Ison Co., Cincinnati, O.; $20,000; railway supplies; Wm. S. Kisinger, S. T. J. C. Ison and Louis A. Brownbeck.

Charles F. Burns Co., Rochester, N. Y.; $5,000; electric railway supplies; Charles F. Barnes, E. M. Higgins and Alfred Green.

United States Elevator & Warehouse Co., Brooklyn, N. Y.; $210,000; George B. Carhart, Isaac H. Cary and Channing Frothingham.

Peninsular Construction Co., Baltimore, Md.; $150,000; A. F. Taylor (Room 8, Keyser Building), E. P. Keech and B. B. Gordon.

Conkling-Armstrong Terra-Cotta Co., Philadelphia, Pa.; $60,000, commencing with $6,000; Thomas F. Armstrong, 4145 Parrish St.

Cheney Dry Mortar & Supply Co., Troy, N. Y.; masons and builders' supplies; $35,000; E. D. Cheney, G. R. Donan and Joseph A. Griffin.

New Birdsall Co., Auburn, N. Y.; threshing machines and sawmills, etc.; $300,000; C. D. MacDougall, E. B. Mosher and Geo. W. Neilis.

Boston Switch Mfg. Co., Portland, Me.; $1,000; electrical apparatus; Pres., C. H. Clark, Boston, Mass.; Treas., R. W. Frost, Boston, Mass.

Buffalo Electrical Transit Co., Buffalo, N. Y.; telegraph and telephone lines; $300,000; Byron J. Tillman, E. J. Woodworth and William W. Read.

Webbs River Improvement Co., Lewiston, Me.; $5,000; dams and booms; Pres., G. B. Bearce, of Lewiston, Me.; Treas., C. C. Wilson, of Auburn, Me.

Simon Mfg. Co., Jersey City, N. J.; $100,000; railway supplies and hand cars; Samuel Simon, Jr., 50 W. 70th St., New York; John Hart, Montclair, N. J.

J. Hall Rohman & Son, Philadelphia, Pa.; $50,000, with $5,000 paid in; iron and brass articles; Treas., John A. Scheel, Jr., 827 Taylor St., Philadelphia.

National Water-Works & Construction Co., Pittsburg, Pa.; $50,000, commencing with $25,000; R. J. Cunningham, W. W. Cunningham and W. E. Lang.

New York Supply & Rubber Co., Montclair, N. J.; $10,000; David A. Woodhouse, Hotel Endicott, New York; Louis B. Boorman, 12 Lloyd Place, Montclair, N. J.

Dumping Car Improvement Co., New York, N. Y.; $1,250,000, commencing with $500; G. S. Bracher, Rahway, N. J.; W. A. H. Stafford and A. B. Stone, New York city.

Knoeller Car Improvement Co., Jersey City, N. J.; $5,000, commencing with $1,000; appliances for electric and cable cars; James Riley, Daniel Y. Lewis and Patrick H. Kilroy.

Nut Lock, Rail Brace & Tie Plate Co., Meridian, Miss.; $100,000, $72,000 subscribed; to operate the Page patents; Pres., H. M. Threefoot; Vice-Pres., O. P. Page; Secy., J. D. McInnis.

American Power Storage Co., New York, N. Y; $500,000, commencing with $250; superheated water motors for street cars; Nathan Guilford, Yonkers, N. Y.; C. C. Paulding, Peekskill, N. Y.; A. B. Holmes, Mount Vernon, N. Y.